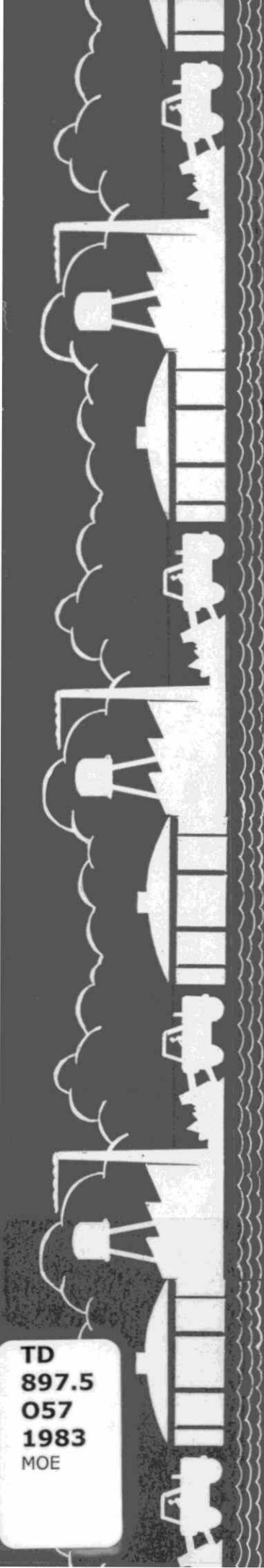

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PROCEEDINGS

30th Ontario Industrial Waste Conference

June 12–15, 1983
The Prince Hotel
Toronto, Ontario

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Ontario
Ministry of the Environment

Hon. Andrew S. Brandt
Minister

Gérard J. M. Raymond
Deputy Minister

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Proceedings
of the
Thirtieth
Ontario Industrial Waste Conference

held at

The Prince Hotel
Toronto, Ontario

June 12–15, 1983

Sponsored by the
Ontario Ministry of the Environment

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ONTARIO INDUSTRIAL WASTE CONFERENCE HISTORICAL DATA

Location	Dates	Sponsor
Ontario Agriculture College, Guelph	1954 to 1956	Pollution Control Board of Ontario
Delawana Inn, Honey Harbour	1957 to 1963	Ontario Water Resources Commission Water & Pollution Advisory Committee
Bigwin Inn, Lake of Bays	1964 & 1965	Ontario Water Resources Commission Water & Pollution Advisory Committee
Park Motor Hotel, Niagara Falls	1966 & 1967	Ontario Water Resources Commission
Sheraton Brock Hotel, Niagara Falls	1968 to 1971	Ontario Water Resources Commission
Skyline Hotel, Toronto	1972 to 1974	Ontario Ministry of the Environment
The Prince Hotel, Toronto	1975 to 1983	Ontario Ministry of the Environment

Conference Chairman	Dates	Secretary/ Co-Ordinator
Dr. A. E. Berry	1954 to 1962	D. S. Caverly/M. Grove
D. S. Caverly	1963 to 1973	L. M. Tobias
K. H. Sharpe	1974 to 1976	M. J. Cathcart (1974)
D. P. Caplice	1977 & 1978	M. F. Cheetham-1975
J. W. Giles	1979 to 1983	to 1983

Program Conveners

1960-1973 F. A. Voege
1974-1978 J. B. Patterson
1979-1983 R. C. Stewart

PREFACE TO THE PROCEEDINGS OF THE 30th ONTARIO INDUSTRIAL WASTE CONFERENCE

The 30th Ontario Industrial Waste Conference had the highest participation ever in the history of the Conference with 611 attendees. The Blueprint for Waste Management sessions on the opening day had the highest registration for any one day in the history of the Conference.

The Conference Planning Committee and the Technical Program Committee is most appreciative of the effort of all authors and session chairmen who contributed so much to this most successful of our Conferences. The papers provided for thoughtful discussion and deliberation, and the chairmanship for each of the sessions was professional in manner and expert in adjudication. The combination of the two made for a Conference which has been deemed one "of the best" in many a year by numerous delegates.

The Conference sponsor, the Ontario Ministry of the Environment, thanks all those who registered. The participation of each individual makes for a better Conference, and in this our 30th, the interest and information exchange was most evident. The combination of the papers and speakers, the session chairmen, and the delegate exchange and interest all contributed to an outstanding and stimulating three days of insight into the industrial waste problems of the day and projected solutions for tomorrow.

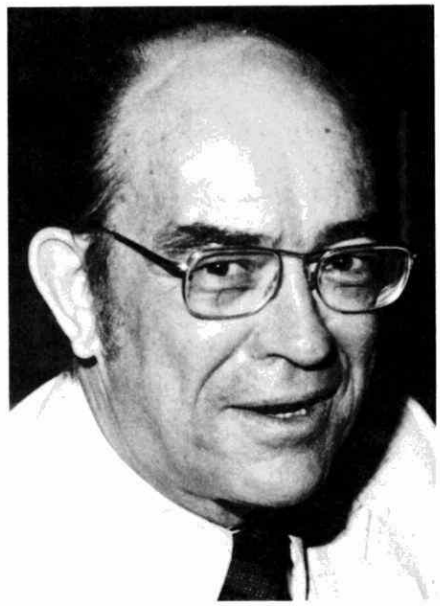
The 31st Conference will again be held at the Prince Hotel in Toronto, June 17–20, 1984. You are invited to attend and interest your fellow industrial environmentalists in also registering. Next year will be Ontario's Bicentennial and some special adjuncts in keeping with the occasion are being planned for the 31st Conference, so be sure and register. In the meantime, the following Proceedings will rekindle the thoughts and ideas that accrued from our 1983 sessions.

J. Walter Giles,
Conference Chairman

CONFERENCE PLANNING COMMITTEE

Conference Chairman
J.W. Giles
Associate Deputy Minister
Intergovernmental Relations and
Strategic Projects
Ontario Ministry of the Environment

Program Convener
R.C. Stewart
Manager Technical Support
West Central Region,
Ontario Ministry of the Environment



Conference Co-Ordinator
M.F. Cheetham
Public Affairs Co-Ordinator
Communications Branch,
Ontario Ministry of the Environment

TECHNICAL PROGRAM COMMITTEE

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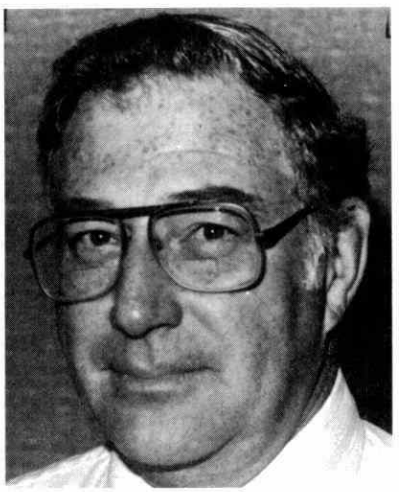
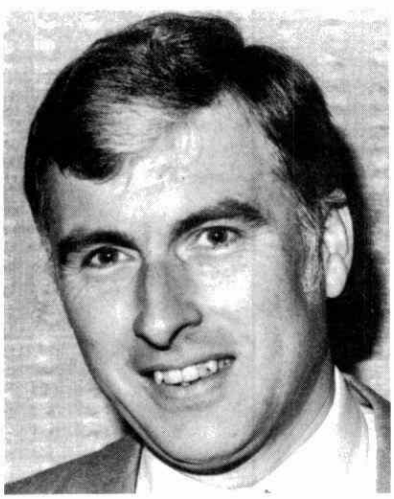
Environmental Approvals Section,
Environmental Approvals and Project
Engineering Branch, Environment Ontario

B. Boyko, Manager
Industrial Section,
Waste Management Branch,
Environment Ontario



C. Duncan
Senior Policy Advisor
Air Resources Branch
Environment Ontario



J. Hawley, Head
Industrial Inorganic Unit
Quality Protection Section
Water Resources Branch,
Environment Ontario

P. Kupa, Head
Regulations and
Enviromental Assessment Unit
Air Resources Branch,
Environment Ontario

THE PAPERS AND THE AUTHORS

at the

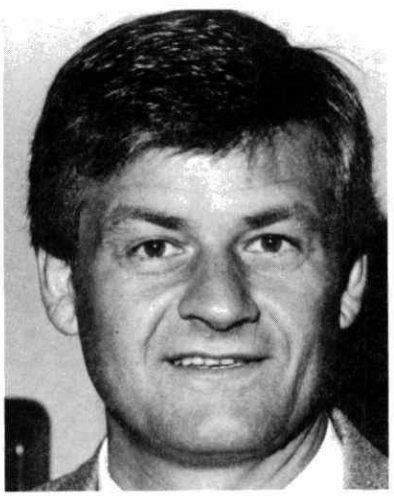
30th ONTARIO INDUSTRIAL WASTE CONFERENCE JUNE 1983 TORONTO, ONTARIO

Chairman: J.W. Giles,
Associate Deputy Minister,
Intergovernmental Relations and
Strategic Projects Division,
Ontario Ministry of the Environment
Toronto, Ontario

The Honourable Keith Norton, Q.C.
Ontario Minister of the Environment

T.D. Armstrong, Blueprint Co-Ordinator
Environment Ontario, Toronto

B. Boyko, Manager Industrial Section,
Waste Management Branch,
Environment Ontario, Toronto



W.R. Balfour, Manager
Municipal Section,
Waste Management Branch,
Environment Ontario, Toronto

A BLUEPRINT FOR WASTE MANAGEMENT: THE CHALLENGE FOR ONTARIO IN THE 1980s

by

THE HONOURABLE KEITH C. NORTON, Q.C.
MINISTER OF THE ENVIRONMENT

In Ontario, we are privileged to enjoy a rich and varied environment.

We want the air we breathe, the water we drink and swim in and the land we walk upon to be protected both now and for future generations from the pollution our activities can create.

It is to satisfy this expectation -- this recognized desire for quality -- that the Ontario government created my ministry and its preceding agencies.

One look around the room here is enough to convince me that you share a concern for and dedication to environmental quality. This is why you are here today.

This conference is positive proof that the public concern is being translated into action, year after year.

I BELIEVE THAT, THROUGH YOUR EFFORTS AND THE EFFORTS OF MY MINISTRY, OTHER ONTARIO GOVERNMENT AGENCIES, OUR MUNICIPALITIES, OUR PROFESSIONAL AND SPECIAL INTEREST GROUPS AND OUR CITIZENS, WE IN ONTARIO CAN CLAIM LEADERSHIP IN OVERALL ENVIRONMENTAL PROTECTION AND MANAGEMENT.

THIS IS REFLECTED IN THE DEMAND FROM OTHER JURISDICTIONS FOR INFORMATION FROM MY MINISTRY; AND THE MARKET WHICH EXISTS AROUND THE WORLD FOR YOUR PROFESSIONAL SERVICES.

WE MUST NOW BUILD ON WHAT WE HAVE ACHIEVED, AND MAINTAIN THIS ROLE OF LEADERSHIP.

LAST NOVEMBER, I SET OUT A CHALLENGE FOR MY MINISTRY, THE WASTE MANAGEMENT INDUSTRY AND THE PEOPLE OF ONTARIO -- ONE OF **THE** CHALLENGES OF THE 1980s.

THAT CHALLENGE IS BETTER MANAGEMENT OF THE EIGHT MILLION TONS OF SOLID WASTE AND THE SIXTY MILLION GALLONS OF INDUSTRIAL WASTE WE GENERATE EVERY YEAR.

I ANNOUNCED THEN MY PERSONAL COMMITMENT TO A COMPREHENSIVE REVIEW AND OVERHAUL OF WASTE MANAGEMENT PRACTICES, POLICIES, CONTROL AND LEGISLATION IN ONTARIO.

THE MAJOR INSTRUMENT IN THIS REVIEW AND OVERHAUL WAS TO BE OUR **BLUEPRINT FOR WASTE MANAGEMENT**.

IN MAKING MY ANNOUNCEMENT, I INVITED THE PEOPLE OF ONTARIO TO CONTRIBUTE THEIR IDEAS TO THE FORMULATION OF THIS IMPORTANT DOCUMENT.

DIRECTLY OR INDIRECTLY, I AM CERTAIN THAT MY CALL HAS REACHED MANY OF YOU HERE TODAY. A NUMBER OF YOU HAVE RESPONDED, AND I HOPE THAT MANY MORE WILL.

AND SO I AM TODAY TABLING ONTARIO'S BLUEPRINT FOR WASTE MANAGEMENT. COPIES OF THE DOCUMENT WILL BE AVAILABLE FOR YOU WHEN YOU BREAK FOR COFFEE.

I WOULD LIKE YOU TO LOOK ON THIS DOCUMENT AS A WORKING DRAWING WITH AN ARTIST'S STRONG CONCEPTION OF A FINISHED PROJECT. WE HAVE APPLIED OUR OWN RESEARCH, AND THE PRELIMINARY SUGGESTIONS WE HAVE RECEIVED, TO SET OUT THE ISSUES, AND FEASIBLE APPROACHES TO THEIR RESOLUTION.

ONE OF THE FOREMOST ISSUES IS THE SHEER QUANTITY OF WASTE WE GENERATE -- FOUR AND A HALF POUNDS OF GARBAGE PER PERSON PER DAY, AND TONS OF SOLID AND LIQUID INDUSTRIAL WASTE, ALL OF WHICH REQUIRE FACILITIES FOR SAFE TREATMENT AND DISPOSAL.

THE FOUR RS OF WASTE MANAGEMENT -- REDUCTION, REUSE, RECOVERY AND RECYCLING -- MUST AND WILL BE A MAJOR PART OF WASTE MANAGEMENT IN OUR PROVINCE.

THERE HAVE BEEN VARIOUS EFFORTS, TO APPLY ONE OR MORE OF THE FOUR RS TO CONSERVE OR RECLAIM VARIOUS WASTES. I HOPE THE EXPERIENCE GAINED BY THE ORIGINATORS OF THESE EFFORTS CAN BE SHARED TO MUTUAL BENEFIT THIS YEAR AS WE WORK TOGETHER TO PLAN AND ESTABLISH ONTARIO'S FUTURE WASTE MANAGEMENT.

I WOULD LIKE YOU TO STOP WITH ME FOR A MOMENT AND LOOK AT EACH OF THE FOUR Rs IN TURN. REDUCTION, REUSE, RECOVERY AND RECYCLING PRESENT THE GREATEST CHALLENGES WE FACE IN BRINGING NEW LIFE TO WASTE MANAGEMENT IN THIS PROVINCE.

AT THE SAME TIME, I BELIEVE THEY PRESENT US WITH SOME OF THE MOST EXCITING OPPORTUNITIES.

REDUCTION:

THE REDUCTION OF WASTE CALLS FOR SOME FIRST-RATE THINKING AND DECISION-MAKING BY A NUMBER OF SECTORS IN OUR SOCIETY.

FOR EXAMPLE, INDUSTRY AND BUSINESS HAVE ROLES TO PLAY IN WASTE REDUCTION. ECONOMIC CONSIDERATIONS HAVE COMPELLED US ALL TO REORIENT OUR OPERATIONS TO ACCOMPLISH MORE WITH LESS. MEANWHILE YOUR CUSTOMERS, THE CONSUMERS OF ONTARIO ARE SPENDING MORE CAREFULLY AND WISELY.

NOW IS THE TIME TO INCREASE THE DURABILITY AND REPAIRABILITY OF PRODUCTS. NOW IS THE TIME TO MODIFY OUR PACKAGING TO ELIMINATE MATERIALS WHICH PROVIDE OBSTACLES TO RECYCLING. AND NOW IS THE TIME, THROUGH MORE EFFECTIVE GOVERNMENT AND NON-GOVERNMENT COMMUNICATIONS TO CHANGE CONSUMERS HABITS, AND REDUCE THE FLOW OF WASTE. OUR TIMING COULD NOT BE BETTER.

REUSE:

DURABILITY IS A MAJOR FACTOR IN ANOTHER OF THE FOUR RS, -- REUSE. THERE ARE A HOST OF MECHANISMS IN PLACE FOR THIS.

ON THE CONSUMER LEVEL, FOR EXAMPLE, REFILLABLE GLASS CONTAINERS FOR BEER ARE REUSED AN AVERAGE OF 20 TIMES, AFTER WHICH THE GLASS MAY BE RECYCLED BY MELTING IT DOWN TO EMERGE AS ANOTHER REFILLABLE CONTAINER.

IF WE ARE TO EXPAND REUSE, WE MUST LOOK TO DURABILITY IN GOODS AND MATERIALS AND CAREFUL MAINTENANCE OF THEIR QUALITIES, TO ENSURE THEIR VALUE TO THE NEXT USER AND THOSE WHO FOLLOW.

RECOVERY

THE THIRD R IN OUR REVIEW IS RECOVERY -- THE PROCESSING OF WASTE TO RECLAIM MATERIAL OR TO PRODUCE ENERGY.

ONTARIO HAS ACHIEVED A REALISTIC PERSPECTIVE ON THE COSTS OF PROCESSING WASTE THROUGH OUR EXPERIMENTAL PLANT FOR RESOURCE RECOVERY IN DOWNSVIEW. AND THE MINISTRY OF ENERGY HAS JOINED US IN THE WASTE RECOVERY FIELD WITH A NUMBER OF ENERGY FROM WASTE PROJECTS.

MY MINISTRY WILL PLAY A LEAD ROLE IN THE WASTE RECOVERY FIELD, ENCOURAGING BROADER APPLICATION OF RECOVERY TECHNOLOGY, CLOSE SCRUTINY OF FACILITIES, AND SUPPORT FOR THE DEVELOPMENT OF SUCH PROJECTS ON A MUNICIPAL LEVEL.

IN ADDITION, I INTEND TO INVESTIGATE THE POSSIBILITY OF A GOOD PACKAGING SEAL OF APPROVAL TO BE DEVELOPED AND JOINTLY ENDORSED BY THE MINISTRY AND INDUSTRY.

I PROPOSE A SIMILAR LEADERSHIP ROLE FOR THE PROVINCE IN CO-ORDINATING PROMOTIONAL EFFORTS FOR MUNICIPALITIES, INDUSTRIES AND RECYCLING GROUPS.

MY MINISTRY IS ALSO PREPARED TO WORK WITH CONCERNED PUBLIC AND PRIVATE SECTOR GROUPS TO ESTABLISH STANDARDS FOR PRODUCTS CONTAINING RECYCLED MATERIALS.

RECYCLING:

RECYCLING IS THE BEST KNOWN OF THE FOUR Rs.

IT RANGES IN SCOPE FROM THE NEIGHBORHOOD BOY SCOUT PAPER DRIVE TO THE INDUSTRIAL EXCHANGE OF THOUSANDS OF GALLONS OF CHEMICALS.

WHILE IT WORKS WELL IN LIMITED COMMERCIAL AND INDUSTRIAL AREAS, ITS POTENTIAL HAS BARELY BEEN TAPPED. IT IS AN AREA WITH ROOM FOR WHOLEHEARTED INVOLVEMENT ON THE PART OF EVERY SECTOR OF OUR SOCIETY.

THE HOUSEHOLDER AND SHOPKEEPER HAVE THE OPPORTUNITY TO SEPARATE THE MARKETABLE MATERIALS FROM THEIR GARBAGE.

THE MUNICIPAL ROLE IS TO CO-ORDINATE COLLECTION OF THESE MATERIALS.

COMMERCE AND INDUSTRY HAVE AN INNER CIRCLE OF RECYCLING WHICH IS ESSENTIALLY STABLE. THE CHALLENGE TO THESE SECTORS IS TO EXPAND INTO THE LARGER COMMUNITY CYCLE AND WORK TO ESTABLISH PRODUCTIVE USES AND STABLE MARKETS FOR A BROADER ASSURED SUPPLY OF MATERIALS.

AND THE RECYCLING WHEEL TURNS FULL CIRCLE TO THE INDIVIDUAL WHO HAS THE POWER TO DEMAND GOODS MADE WITH RECYCLED MATERIALS.

WITHIN THIS RECYCLING CIRCLE, WE HAVE THE NON-GOVERNMENT, ENVIRONMENTALLY ORIENTED SPECIAL INTEREST GROUPS. THEY HAVE ESTABLISHED A ROLE FOR THEMSELVES IN PROVIDING EDUCATION, INITIATIVE, IMAGINATION AND THE SPIRIT TO MAKE RECYCLING WORK.

THE CHALLENGE FOR THESE GROUPS IS ESSENTIALLY TO DO BETTER -- TO SHARE THEIR IMAGINATION AND SPIRIT WITH INDUSTRY, FOR EXAMPLE, AND IN RETURN LEARN FROM INDUSTRY'S EXPERIENCE AND PRACTICALITY.

THE CHALLENGE FOR GOVERNMENT IS, QUITE SIMPLY, TO MAKE IT WORK. MORE DIRECTLY, I SEE MY ROLE AND MY MINISTRY'S ROLE AS WORKING WITH YOU TO MAKE YOUR PART OF THE CYCLE PERFORM MORE EFFECTIVELY.

IN OUR BLUEPRINT WE SET OUT SOME IDEAS ON WHAT WE ARE DOING AND CAN DO.

WE PROVIDE SEED MONEY TO START AND STABILIZE REGIONAL SOURCE SEPARATION PROGRAMS. WITHIN THE ONTARIO GOVERNMENT, WE HAVE IMPLEMENTED A COST-EFFECTIVE SOURCE SEPARATION PROGRAM FOR FINE PAPER AND MADE A GOOD START ON ENCOURAGING SIMILAR PROGRAMS IN THE PRIVATE SECTOR.

WE HAVE BEEN WORKING STEADILY ON PUBLIC EDUCATION AND WE INTEND TO DO MORE.

I AM ASKING FOR RESPONSE FROM ALL SECTORS OF ONTARIO SOCIETY ON HOW MY MINISTRY AND I CAN MOST EFFECTIVELY CONTRIBUTE TO SUBSTANTIAL AND STABLE SUPPLIES OF RECYCLABLE MATERIALS, AN EFFECTIVE SYSTEM OR SYSTEMS FOR THEIR COLLECTION AND DELIVERY AND AN ASSURED MARKET FOR THEIR USE.

And I am challenging all sectors of Ontario society to find ways of making their own substantial contribution.

If I may digress slightly, for a moment, when you pick up your copy of the printed Blueprint look for a brief note on the front cover.

Read it and you will find the paper on which we have printed the report contains recycled fibre. My best guess is about 30 per cent recycled content. To get 100 per cent recycled paper of this grade we would have to buy it from the United States.

I want to buy and use paper which has the maximum recycled content for communication in my Ministry. But I also want to buy Ontario products as much as possible.

These two interests cannot be resolved until there is a demand in this province for materials and goods which are the product of recycling.

ITS UP TO US TO CREATE THAT DEMAND -- TO MAKE RECYCLED CONTENT A POSITIVE ASSET IN THE MARKETPLACE.

MY STAFF IS INVESTIGATING THE INTRICACIES OF GOVERNMENT PURCHASING AND I AM GOING TO SEE WHAT I CAN DO ABOUT INCREASING GOVERNMENT DEMAND FOR RECYCLED CONTENT ACROSS THE BOARD.

I ASK AND URGE ALL OF YOU TO SEE WHAT YOU CAN DO TO HELP CREATE THIS MARKET DEMAND -- TO JOIN ME IF YOU CAN.

A DISPOSAL FEE?

BEYOND THIS, I WOULD LIKE TO PROPOSE FOR DISCUSSION THE POSSIBILITY OF A DISPOSAL FEE TO BE LEVIED AT ALL TREATMENT AND DISPOSAL FACILITIES AGAINST ALL WASTES RECEIVED. THIS FEE MIGHT WELL BE HIGHER FOR THE MORE COMPLEX AND HAZARDOUS WASTES.

THE REVENUE FROM THIS COULD BE APPLIED TO OFFSET SOME OF THE CAPITAL COSTS OF PROCESSING FACILITIES AND TO PROVIDE FUNDING FOR SOURCE SEPARATION, EDUCATION AND DEMONSTRATION PROJECTS RELATED TO THE FOUR Rs.

THIS FEE COULD HAVE A SIGNIFICANT IMPACT ON WASTE MANAGEMENT PRACTICES. FIRST AND FOREMOST, IT WOULD GENERATE FUNDING FOR THE FOUR Rs.

EQUALLY IMPORTANT, IT WOULD CLOSE THE COST GAP BETWEEN THE SIMPLE DUMPING SOLUTION AND THE ALTERNATIVES OF REDUCTION, REUSE, RECOVERY AND RECYCLING.

COST ACCOUNTING

THE WHOLE QUESTION OF COST EFFECTIVENESS IN WASTE MANAGEMENT IS ANOTHER ISSUE THAT CONCERNS ME AND, FROM WHAT I HAVE BEEN ABLE TO GATHER, IT CONCERNS AN INCREASING NUMBER OF INFORMED PEOPLE IN ONTARIO.

ALL TOO OFTEN, I BELIEVE, WE ARE TAKING TOO SUPERFICIAL AN ACCOUNTING OF THE REAL COSTS OF WASTE DISPOSAL. IT IS AN ACCEPTED MAXIM THAT LANDFILL IS THE CHEAPEST METHOD OF DISPOSING WASTES WHETHER THEY BE SOLID OR LIQUID, MUNICIPAL, COMMERCIAL OR INDUSTRIAL.

BUT HOW REALISTIC IS THAT MAXIM? DO WE REALLY COUNT **ALL** THE COSTS? COMPREHENSIVE WASTE MANAGEMENT ACCOUNTING IN OUR PLANNING WILL ALLOW US MORE RESPONSIBLE AND EFFICIENT CHOICES OF FUTURE WASTE MANAGEMENT OPTIONS.

LANDFILL:

LANDFILLING, FOR INSTANCE IS NOT ALWAYS THE INEXPENSIVE AND SIMPLE SOLUTION YOU MAY THINK IT IS.

THE TRUE COSTS OF LANDFILLING INCLUDE PLANNING, TECHNICAL STUDIES OF ALTERNATIVE SITES, HEARINGS AND APPROVALS, LAND ACQUISITION, OPERATING COSTS, MONITORING, LEACHATE AND RUNOFF CONTROLS, CLOSURE AND POST-CLOSURE PROTECTIVE MEASURES.

CUTTING CORNERS IN ANY OF THESE AREAS INCREASES THE RISKS TO OUR HEALTH AND OUR ENVIRONMENT AND ALSO INCREASES THE ULTIMATE COSTS TO THE COMMUNITY.

PLANNING:

WASTE MANAGEMENT BEGINS WITH PLANNING AND THIS IS AN AREA WHERE THE TEMPTATION IS GREATEST FOR SOME MUNICIPALITIES TO TAKE SHORT CUTS IN THE INTERESTS OF EXPEDIENCY.

THERE ARE SEVERAL MUNICIPALITIES WHICH ASSUME A DEGREE OF RESPONSIBILITY FOR ALL WASTES PRODUCED IN THEIR JURISDICTION, AND FOR LONG-TERM AREA WASTE MANAGEMENT PLANNING TO COPE WITH THESE WASTES. HOWEVER, THIS IS NOT THE CASE WITH ALL MUNICIPALITIES -- BUT I INTEND TO ENSURE THAT IT WILL BE.

MUNCIPALITIES MUST STRIVE FOR A BETTER QUALITY IN WASTE MANAGEMENT PLANNING, INCORPORATING MORE CONSTRUCTIVE PUBLIC CONSULTATION TO REDUCE THE ATMOSPHERE OF CONFLICT WHICH PREVAILS IN SO MANY WASTE SITE DECISIONS TO DATE.

I REGARD THE ISSUE OF MUNICIPAL PLANNING AS A CRITICAL AREA OF THE BLUEPRINT.

PERPETUAL CARE

ANOTHER AREA TO WHICH WE HAVE TURNED OUR ATTENTION IS THE FEAR PRESENT IN THE MINDS OF THE PUBLIC, THAT BURIED WASTES WILL SOME DAY COME BACK TO HAUNT US.

WE ARE THEREFORE PROPOSING A PERPETUAL CARE PROGRAM TO ENSURE THAT ANY PROBLEMS ARISING CAN BE SAFELY AND EFFICIENTLY RESOLVED.

IN THIS PERPETUAL CARE PROGRAM, WE ARE DEVELOPING A PROPOSAL OF GUARANTEED PROTECTION WHICH PROVIDES FINANCIAL ASSURANCES TO COVER EVERY STAGE OF THE LIFE OF A SITE AND CONTINUING INSURANCE AFTER ITS CLOSURE.

ENFORCEMENT:

In our leadership role with respect to control measures, regulations and assignments of responsibility, my Ministry also recognizes a clear need to ensure consistent performance on the part of all responsible parties.

I have just reviewed a quarterly status report on enforcement and I can report that we have one hundred and eleven (111) control orders, requirements and directions and control programs to ensure consistent progress in dealing with specific environmental problems.

In addition, my Ministry's legal staff are maintaining a full slate of activity with increasing emphasis on waste management issues.

The regulations we produce from this Blueprint process **will be enforced**. I intend to be fair, but I assure you that our enforcement will be firm.

In making this point, I urge you to look to your own standards of performance and stand ready to account to your peers for your actions.

RESPONSIBILITY:

While protective measures are an important element in waste management, there are more positive elements to our Blueprint which relate to performance.

We have set out to define all aspects of waste management in terms of roles and responsibility coupled with accountability.

Performance hinges on a clear, mutual understanding of our respective responsibilities and the roles of other sectors of our society.

Throughout the Blueprint you will find ideas on what the individual or the community can and should do. The same applies to municipalities, provincial agencies and the private sector.

Our final plan is meaningless if we do not implement it with the full co-operation of all involved.

Your contribution is just as necessary in the continuing process of waste management as it is in the planning and development of the Blueprint.

THE ROAD AHEAD:

We want you to comment, to criticize and to contribute.

Over the next few months, my staff and I will be talking to and listening to as many groups and interests across Ontario as possible. We will be conducting an active campaign to get people involved in the waste management decisions which must be made to complete the Blueprint.

This will be followed by a series of public meetings at which my Ministry's Blueprint team will receive and hear further submissions in detail.

THEN AND ONLY THEN, WE WILL TAKE ALL THE CONTRIBUTIONS FROM ALL SEGMENTS OF OUR SOCIETY, TO FORGE THE FINAL WORKING PLAN FOR WASTE MANAGEMENT IN ONTARIO THROUGH THE 80S AND THE DECADES BEYOND.

THIS PLAN WILL TAKE FORM IN NEW LEGISLATION, REGULATIONS, PRACTICES AND WORKING RELATIONSHIPS.

YOU WILL BE HEARING OUR PROPOSALS IN MUCH GREATER DETAIL THIS MORNING FROM THE KEY PEOPLE ON OUR BLUEPRINT FOR WASTE MANAGEMENT TEAM.

OUR CO-ORDINATOR, TOM ARMSTRONG WILL BE EXPANDING ON MY REMARKS CONSIDERABLY AND BILL BALFOUR AND BORIS BOYKO WILL DISCUSS SOME SPECIFIC AREAS OF CONCERN.

FINALLY, YOUR CONFERENCE CHAIRMAN, WALTER GILES HEADS UP THE BLUEPRINT TEAM.

I INVITE YOU TO QUESTION ALL OF THEM AFTER THEIR PRESENTATIONS, AND I ASSURE YOU THAT YOUR INTEREST WILL BE WELCOME.

That is the challenge -- working together first to plan, then to implement, and finally to maintain consistent performance.

Our reward is the maintenance of clean, safe, healthy communities in a clean, safe and healthful province.

Once again, the Blueprint for Waste Management is in your hands.

AN EXPANSION OF THE TECHNICAL DETAILS & LEGISLATIVE IMPLICATIONS OF THE BLUEPRINT FOR WASTE MANAGEMENT IN THE 1980s

BY

THOMAS D. ARMSTRONG

BLUEPRINT CO-ORDINATOR

ONTARIO MINISTRY OF THE ENVIRONMENT

I'M SURE ALL OF YOU ARE FAMILIAR WITH TV **NEWSBREAKS**; THOSE MINI-NEWSCASTS THAT RUN BETWEEN TV PROGRAMS. THEY TELL YOU WHAT THE TOP NEWS STORIES OF THE DAY ARE, AND ONCE THEY'VE WHETTED YOUR APPETITE, THEY SAY:

"DETAILS AND FILM AT 11."

WELL, IT'S NOT QUITE 11. I DON'T HAVE ANY FILM. BUT I DO HAVE THE DETAILS -- SOME OF THEM.

AFTER ALL, THE BLUEPRINT ITSELF IS 70 PAGES LONG, AND THERE ARE ALSO ABOUT 500 PAGES OF APPENDICES. THERE ARE A LOT OF DETAILS. NOW I AM SURE THAT EACH OF YOU IS DETERMINED TO GO HOME TONIGHT AND READ EACH PAGE OF THE BLUEPRINT.

BUT, THINGS HAPPEN. SOMETHING URGENT -- SOMETHING REALLY URGENT -- JUST MIGHT PREVENT YOU FROM CURLING UP WITH THIS DOCUMENT.

SO, I'D LIKE TO GIVE YOU ALL THOSE DETAILS RIGHT NOW.

BUT I CAN'T. I DON'T HAVE ENOUGH TIME. BUT I CAN EXPAND ON SOME OF THE POINTS THE MINISTER MADE, IN ORDER TO GIVE YOU A FULLER PICTURE -- A MORE COMPREHENSIVE VIEW -- OF THE TOTAL SCOPE OF THE BLUEPRINT FOR WASTE MANAGEMENT.

I'LL DO SO BY GIVING YOU A SUMMARY OF THE MAJOR TOPICS YOU'LL FIND IN THE BLUEPRINT ITSELF.

FIRST, HOWEVER, LET ME GIVE YOU SOME BACKGROUND.

I, PERSONALLY, FIRST BECAME INVOLVED WITH THE ACTIVITIES WHICH LED TO THE BLUEPRINT IN JANUARY OF 1982, AND HAVE BEEN WORKING ON IT FULLTIME EVER SINCE.

I HAVEN'T BEEN ALONE. MANY OTHERS HAVE BEEN INVOLVED, AND THE NUMBER IS GROWING.

SINCE WORK STARTED, WE HAVE DONE A GREAT DEAL OF RESEARCH, TALKED TO MANY INDIVIDUALS AND GROUPS -- TO SOME OF YOU RIGHT HERE TODAY -- AND DRAWN UPON ALL THE ACCUMULATED KNOWLEDGE AND EXPERIENCE AVAILABLE TO US.

WE DID THIS TO PREPARE THIS BLUEPRINT AS A STARTING POINT FOR DISCUSSION, CONSULTATION AND PARTICIPATION.

THE ACCUMULATED KNOWLEDGE AND EXPERIENCE WE HAVE DRAWN UPON INCLUDES OUR OWN. WE ARE, AFTER ALL, AN AGENCY WITH A LONG HISTORY OF ENVIRONMENTAL CONCERNS AND EXPERIENCE.

BACKGROUND TO WASTE MANAGEMENT

AFTER ALL, THE MINISTRY OF THE ENVIRONMENT CAN TRACE ITS LINEAGE BACK TO THE ONTARIO WATER RESOURCES COMMISSION WHICH WAS FOUNDED IN 1957 -- A QUARTER OF A CENTURY AGO.

IN THE 60S, ONTARIO DEVELOPED THE AIR POLLUTION CONTROL ACT. THE ENVIRONMENTAL PROTECTION ACT WAS PASSED IN 1972.

AND IN 1970 WE HAD INTRODUCED THE WASTE MANAGEMENT ACT. SINCE THEN, THERE HAS BEEN A STEADY ACCUMULATION OF INFORMATION AND EXPERTISE CONTRIBUTING TO EVEN MORE SOPHISTICATED WASTE MANAGEMENT PRACTICES.

THE BLUEPRINT FOR WASTE MANAGEMENT -- AND THE ENABLING LEGISLATION IT CALLS FOR -- IS THE NEXT LOGICAL STEP IN THE PROTECTION AND IMPROVEMENT OF ONTARIO'S ENVIRONMENT.

WE ALL HAVE A ROLE

EACH OF ONTARIO'S 8.5 MILLION PEOPLE -- EACH OF US HERE TODAY -- GENERATES APPROXIMATELY 4.5 POUNDS OF GARBAGE EVERY DAY. THAT ADDS UP TO ABOUT SEVEN MILLION TONS OF GARBAGE A YEAR, **PLUS** 60 MILLION GALLONS OF HAULED LIQUID WASTE EVERY YEAR. AND OF THAT 60 MILLION GALLONS, BETWEEN SIX AND NINE MILLION GALLONS ARE TOXIC OR HAZARDOUS.

THOSE FIGURES KEEP GROWING. THE TONS KEEP PILING UP. THAT'S WHY THE MINISTER ESTABLISHED FOUR MAJOR PRINCIPLES TO SERVE AS THE FRAMEWORK FOR THE BLUEPRINT. THEY ARE:

1] AS MANY RECOVERABLE AND USABLE MATERIALS AND ENERGY RESOURCES AS POSSIBLE MUST BE RECLAIMED FROM THE GARBAGE WE PRODUCE;

2] THOSE WHO ARE RESPONSIBLE FOR PRODUCING, HANDLING AND DISPOSING OF WASTES MUST BE ACCOUNTABLE FOR THE WAY THEY EXECUTE THEIR RESPONSIBILITIES;

3] AS RESPONSIBLE PARTIES, WE MUST BE INFORMED ON THE ISSUES AND TAKE PART IN THE DECISIONS WHICH MUST BE MADE TO RESOLVE THEM; AND

4] OUR DISPOSAL PRACTICES MUST ENSURE THAT NO WASTE EVER BECOMES A THREAT TO EITHER OUR ENVIRONMENT OR OUR WELL BEING.

THOSE ARE THE FOUR GUIDING PRINCIPLES. THEY ARE SIMPLE AND STRAIGHTFORWARD.

SO ARE THE ROLES WE ALL MUST FILL.

MINISTRY'S ROLE

THE MINISTRY OF THE ENVIRONMENT HAS TWO MAJOR ROLES.

FIRST, WE HAVE A REGULATORY ROLE CONCERNED WITH CONTROL AND ENFORCEMENT.

SECOND, WE HAVE A MANAGERIAL ROLE. THIS ALSO INCLUDES RESEARCH AND DEVELOPMENT, THE PROVISION OF FUNDING TO ENCOURAGE LONG-TERM PLANNING, AND THE ENCOURAGEMENT OF THE FOUR R'S THE MINISTER WAS SPEAKING ABOUT EARLIER; REDUCTION, REUSE, RECYCLING AND RECOVERY.

MUNICIPAL ROLE

MUNICIPALITIES SHOULD ASSUME GREATER RESPONSIBILITY IN TERMS OF WASTE MANAGEMENT PLANNING; CO-ORDINATING IT WITH OTHER MUNICIPAL UTILITIES AND LAND-USE ACTIVITIES.

TO DO THIS, EACH MUNICIPALITY SHOULD HAVE ITS OWN COMPREHENSIVE AND LONG-TERM WASTE MANAGEMENT MASTER PLAN. THIS PLAN SHOULD CONTAIN THE TRUE COST OF WASTE MANAGEMENT.

BUT WE ALSO REALIZE THAT THERE MUST BE ENOUGH FLEXIBILITY BUILT INTO THE SYSTEM TO ALLOW MUNICIPALITIES, COUNTIES AND REGIONAL GOVERNMENTS TO ASSUME THOSE RESPONSIBILTIES THEY ARE BEST QUALIFIED TO PERFORM.

INDUSTRY'S ROLE

PRIVATE INDUSTRY ALSO HAS A ROLE AND, DUE TO MEDIA ATTENTION, A VERY PUBLIC ROLE.

WE ARE ALL AWARE THAT SOME INDUSTRIES MUST DEAL WITH HAZARDOUS WASTE. MUCH OF THAT AWARENESS COMES FROM THE MEDIA WHICH HAS FOCUSED PUBLIC ATTENTION ON THE DANGERS OF INADEQUATE WASTE MANAGEMENT.

BUT WHETHER HAZARDOUS OR NOT, INDUSTRY IS RESPONSIBLE FOR THE HANDLING AND TREATMENT OF THE WASTE IT PRODUCES.

NOW WE ALL KNOW THAT INDUSTRY HAS TO BALANCE THE COST OF WASTE MANAGEMENT -- PART OF THE COST OF DOING BUSINESS -- WITH THE DEMANDS OF PUBLIC WELFARE.

TO HELP MAINTAIN THE BALANCE, THE MINISTRY IS PROPOSING TO INTRODUCE NEW REGULATIONS. THESE WILL DEAL WITH THREE INDUSTRIAL CATEGORIES: WASTE GENERATORS, CARRIERS AND RECEIVERS.

PUBLIC'S ROLE

THE PUBLIC -- US -- WE ALSO GENERATE WASTE. WE ARE ALSO AFFECTED BY WASTE MANAGEMENT. THAT'S WHY ALL OF US, AS PRIVATE CITIZENS, HAVE A RIGHT TO BE INFORMED ABOUT WHAT IS HAPPENING IN TERMS OF WASTE MANAGEMENT: POLICIES, RULES, REGULATIONS, LEGISLATION, R AND D, AND EVERY OTHER ASPECT OF THE SITUATION.

THE PUBLIC MUST BE EDUCATED -- REMINDED -- OF THE CONSEQUENCES OF WASTE AND OF THE BENEFITS OF PRACTICING THE FOUR R'S.

THE PUBLIC MUST ALSO REMEMBER THAT NO MATTER HOW MUCH WE REDUCE WASTE, THERE WILL ALWAYS BE SOME; AND A NEED FOR LANDFILL SITES TO DISPOSE OF IT.

THE PUBLIC'S RESPONSIBILITY IS TO INFORM ITSELF, TO BE AWARE OF WHAT IS GOING ON.

CLASSIFYING WASTES

AS THE MINISTER SAID A FEW MINUTES AGO, THE CLASSIFICATION AND CONTROL OF WASTES IS A KEY AREA IN TERMS OF ENVIRONMENTAL PROTECTION.

IT IS ESPECIALLY IMPORTANT WHEN YOU REALIZE THAT ALL WASTES -- EVEN HOUSEHOLD GARBAGE -- CAN CAUSE ENVIRONMENTAL PROBLEMS IF THEY ARE NOT HANDLED OR TREATED OR DISPOSED OF PROPERLY.

NOW, MOST OF YOU KNOW THAT CURRENTLY, ALL WASTES ARE CLASSIFIED AND DEFINED UNDER REGULATION 309 OF THE ENVIRONMENTAL PROTECTION ACT. MOST OF YOU ALSO KNOW THAT SOME OF THOSE DEFINITIONS ARE A LITTLE ON THE VAGUE SIDE.

SO, TO PREVENT FUTURE PROBLEMS, WE ARE PROPOSING A NEW CLASSIFICATION SYSTEM WHICH WILL BREAK WASTE DOWN INTO THREE MAIN CATEGORIES: SPECIAL WASTE, CONTROLLED WASTE AND MUNICIPAL WASTE.

BY THE WAY, HAZARDOUS AND HAULED LIQUID WASTES ARE CONSIDERED SPECIAL WASTES. AND LATER THIS MORNING, BORIS BOYKO, MANAGER OF THE MINISTRY'S INDUSTRIAL WASTE SECTION, WILL BE GIVING YOU A VERY DETAILED PRESENTATION ON THE SUBJECT.

THE FOUR R's

THE MINISTER HAS ALREADY PROVIDED A DETAILED REVIEW OF THE FOUR R'S, SO I WON'T ELABORATE.

AUTHORITY AND RESPONSIBILITY

JUST AS WE PROPOSE TO SHARPEN OUR DEFINITIONS OF WASTE CLASSIFICATIONS IN REGULATION 309, WE ALSO PROPOSE TO PROVIDE A MORE PRECISE DELINEATION OF THE RESPONSIBILITIES -- AND AUTHORITIES -- EACH **PARTNER** HAS IN WASTE MANAGEMENT.

WE ARE **PARTNERS** IN THIS. ALL OF US: THE PROVINCE, THE MUNICIPAL GOVERNMENTS, INDUSTRY AND THE PUBLIC.

SO, ALONG WITH OUR EVOLVING ROLES COMES GROWING RESPONSIBILITIES AND AUTHORITIES.

MINISTRY'S RESPONSIBILITIES

THE PROVINCE INITIALLY PERFORMED PURELY A REGULATORY ROLE IN WASTE MANAGEMENT.

YOU, MORE THAN MOST, KNOW HOW MUCH THAT HAS CHANGED.

IT WILL CHANGE EVEN MORE.

WE IN THE MINISTRY FEEL THAT WE HAVE A MAJOR RESPONSIBILITY TO PROVIDE ADMINISTRATIVE AND TECHNICAL GUIDANCE TO BOTH MUNICIPALITIES AND PRIVATE INDUSTRY.

THAT IS WHY WE ARE NOW -- AND WILL CONTINUE TO BE -- ACTIVELY INVOLVED IN DEVELOPING THE NECESSARY NEW TECHNOLOGIES AND TECHNICAL KNOWLEDGE FOR WASTE MANAGEMENT.

THIS IS ALSO WHY WE PLAN TO PASS THIS TECHNOLOGY, THIS KNOWLEDGE, ON TO YOU.

AND THROUGH THE ONTARIO WASTE MANAGEMENT CORPORATION, THE PROVINCE HAS ACCEPTED A RESPONSIBILITY FOR THE TREATMENT AND DISPOSAL OF SPECIAL WASTE.

MINISTRY'S RESPONSIBILITIES

TRADITIONALLY, MUNICIPALITIES HAVE ACCEPTED RESPONSIBILITY FOR THE COLLECTION AND DISPOSAL OF DOMESTIC AND SOME COMMERCIAL WASTE.

WE PROPOSE THAT MUNICIPALITIES ACCEPT A DEGREE OF RESPONSIBILITY FOR **ALL** THE WASTES PRODUCED WITHIN THEIR BOUNDARIES: MUNICIPAL, CONTROLLED AND SPECIAL.

I'M NOT SAYING TOTAL RESPONSIBILITY, BUT I AM SAYING MORE RESPONSIBILITY. THIS INCLUDES AREAS SUCH AS WASTE INVENTORY AND PLANNING.

THERE IS ALSO A NEED FOR MORE INTER-MUNICIPAL CO-OPERATION. THERE ARE TIMES, FOR EXAMPLE, WHEN NO SUITABLE SITES CAN BE FOUND IN A PARTICULAR MUNICIPALITY OR GROUP OF MUNICIPALITIES.

THIS LEADS TO NEGOTIATIONS WITH OTHER AREAS FOR ACCESS TO DISPOSAL SITES. AS A RULE, THOSE NEGOTIATIONS DON'T WORK OUT TOO WELL.

SO, THERE IS A SUGGESTION THAT PROVINCIAL LEGISLATION BE AMENDED TO ALLOW A MUNICIPALITY TO APPEAL TO AN AGENCY, LIKE THE ONTARIO MUNICIPAL BOARD, FOR A BINDING DECISION IN SUCH CASES; A BINDING DECISION WHICH COULD ALSO INCLUDE COSTS.

WE REALIZE THAT THIS WILL BE A SUBJECT OF A GREAT DEAL OF CONVERSATION AND DEBATE OVER THE NEXT FIVE MONTHS. WE'RE LOOKING FORWARD TO IT.

INDUSTRIAL RESPONSIBILITY

INDUSTRY HAS TWO PRIMARY RESPONSIBILITIES IN WASTE MANAGEMENT.

THE FIRST IS PROPER MANAGEMENT OF THE SPECIAL WASTES IT PRODUCES. THAT INCLUDES DOING THE NECESSARY PLANNING FOR DEALING WITH THEM.

THE SECOND ONE IS TO REDUCE ITS WASTES.

THE MINISTRY IS PROPOSING SEVERAL LEGISLATIVE CHANGES TO ENSURE THAT INDUSTRIAL OPERATORS TAKE GREATER RESPONSIBILITY FOR SAFE AND EFFICIENT WASTE HANDLING, TRANSPORTATION, PROCESSING AND DISPOSAL.

BORIS BOYKO WILL HAVE MORE DETAILS ABOUT THAT LATER THIS MORNING. YOU WILL ALSO FIND MORE ABOUT IT IN APPENDIX EIGHT OF THE BLUEPRINT.

WHAT I SAID A FEW MINUTES AGO ABOUT MUNICIPAL RESPONSIBILITIES APPLIES HERE AS WELL. WE REALIZE THAT THIS WILL BE A SUBJECT OF A GREAT DEAL OF CONVERSATION AND DEBATE OVER THE NEXT FIVE MONTHS. WE'RE LOOKING FORWARD TO IT.

PUBLIC RESPONSIBILITIES

OVER THE LAST DECADE, THERE HAS BEEN AN INCREASE IN PUBLIC INTEREST -- AND AWARENESS -- ABOUT WASTE MANAGEMENT.

THE MINISTRY BOTH APPRECIATES AND DESIRES PUBLIC INVOLVEMENT, AND ONE OF THE MAJOR OBJECTIVES OF THE BLUEPRINT IS TO GENERATE EVEN MORE PUBLIC INVOLVEMENT AND CONSULTATION.

DURING THE NEXT FIVE MONTHS, THE FIVE MONTHS AFTER WHICH THE **FINAL** BLUEPRINT WILL ACTUALLY BE WRITTEN, WE WILL BE BOTH GOING TO THE PUBLIC AND ASKING THE PUBLIC TO COME TO US.

SUCH PUBLIC CONSULTATION PROVIDES A BACKGOURND OF **SOUND INFORMATION**, AND ALLOWS THE PUBLIC TO EXPRESS THEIR OWN VIEWS, AND VOICE THEIR CONCERNS, VALUES AND ATTITUDES.

PLEASE NOTE THAT I SAID **SOUND INFORMATION**.

PEOPLE HAVE A RIGHT TO EXPRESS THEIR CONCERNS. THEY ALSO HAVE A RESPONSIBILITY TO STUDY AND LEARN ALL SIDES AND ALL THE VARIOUS ASPECTS OF THE ISSUES THEY WILL BE TALKING ABOUT.

AREA WASTE MANAGEMENT PLANNING

AREA WASTE MANAGEMENT PLANNING, STATED SIMPLY, MEANS DEVELOPING WASTE MANAGEMENT SYSTEMS FOR PARTICULAR GEOGRAPHIC AREAS. THIS WOULD INCLUDE THE EVALUATION OF BOTH THE LONG AND SHORT-TERM OPTIONS AVAILABLE.

MUNICIPALITIES MUST CARRY OUT LONG-TERM PLANNING, AND CO-ORDINATE IT WITH OTHER MUNICIPAL LAND USE PLANNING TO BOTH PROTECT THE ENVIRONMENT AND AVOID POTENTIAL LAND USE CONFLICTS.

AS MOST OF YOU KNOW, THE MINISTRY HAS PROVIDED 50 PER CENT OF THE COST OF MUNICIPAL AREA WASTE MANEGEMENT STUDIES SINCE 1971. IN THE PAST, THOSE STUDIES WERE LIMITED TO MUNICIPAL WASTE MANAGEMENT AND THE SELECTION OF DISPOSAL FACILITIES.

RECENTLY, HOWEVER, THE MINISTRY HAS PARTICIPATED IN FINANCING PLANS WITH BROADER SCOPES -- THOSE DEALING WITH ALL TYPES OF WASTE: MUNICIPAL, CONTROLLED AND SPECIAL.

BUT THE BASIC REQUIREMENT IS STILL THE SAME -- PLANNING.

AS WE SEE IT, THERE ARE SEVEN ESSENTIAL ELEMENTS TO ANY AREA WASTE MANAGEMENT PLAN.

1] IT SHOULD BE A 20-YEAR PLAN, AND BE UPDATED EVERY FIVE YEARS.

2] IT SHOULD INCLUDE AN INVENTORY AND ASSESSMENT OF EXISTING WASTE MANAGEMENT FACILITIES AND TRANSPORTATION NETWORKS AS WELL AS AN EVALUATION OF THE REMAINING USEFUL LIFE OF EXISTING FACILITIES AND POTENTIAL USES FOR THEM ONCE THEY ARE CLOSED.

3] THERE SHOULD BE AN INVENTORY OF CURRENT WASTES -- IN TERMS OF TYPES AND QUANTITIES -- AS WELL AS PROJECTIONS OF POSSIBLE FUTURE CHANGES.

4] IT SHOULD SET OUT REQUIREMENTS FOR NEW FACILITIES, INCLUDING THE TIMING OF THEIR OPENING.

5] THE DEVELOPMENT AND ASSESSMENT OF THE CAPITAL AND OPERATING COSTS OF ALL THE SYSTEMS AND THEIR OPTIONS SHOULD BE CONSIDERED.

6] SYSTEM OPTIONS SHOULD BE EVALUATED IN TERMS OF ALL POSSIBLE EFFECTS -- TECHNICAL, ENVIRONMENTAL, ECONOMIC AND SOCIAL. THEY MUST ALSO BE CONSIDERED IN RELATION TO PROVINCIAL GOALS AND OTHER MUNICIPAL PLANNING.

7] THERE SHOULD BE A DETAILED DEVELOPMENT SCHEDULE WHICH INCLUDES CRITICAL DATES FOR THE DESIGN STAGE, ENVIRONMENTAL ASSESSMENT, DEVELOPMENT, OPERATION, CLOSURE AND POST-CLOSURE.

ONE FINAL POINT ON THIS.

AREA WASTE MANAGEMENT PLANNING MUST ALSO INCLUDE A PROGRAM OF PUBLIC INFORMATION AND PUBLIC INVOLVEMENT.

HEARINGS, APPROVALS AND APPEALS

SOME PEOPLE LOOK AT THE ENTIRE PROCESS OF HEARINGS, APPROVALS AND APPEALS AS A BOTTLENECK.

AT TIMES, THEY'RE RIGHT.

THAT'S WHY WE'RE PROPOSING SOME CHANGES. WE WANT TO SIMPLIFY AND SPEED UP THE PROCESS.

IN THE PAST THERE HAVE BEEN PROBLEMS BECAUSE OF:

1] UNCERTAINTY REGARDING REQUIREMENTS FOR ENVIRONMENTAL ASSESSMENT;

2] THE POTENTIAL FOR DUPLICATION OF HEARINGS LEADINGS TO DELAYS AND ADDITIONAL COSTS; AND

3] THE APPLICATION OF TWO DIFFERENT STATUTES -- THE ENVIRONMENTAL PROTECTION ACT AND THE ENVIRONMENTAL ASSESSMENT ACT -- AND THREE DIFFERENT HEARING PROCESSES DEALING WITH WASTE MANAGEMENT.

I DON'T WANT TO, OR HAVE TO, TELL YOU THE SORTS OF PROBLEMS THESE CAUSE. WE ALL KNOW THEM.

WE PROPOSE THAT THE APPLICATION OF THE ENVIRONMENTAL ASSESSMENT ACT BE BROADENED TO INCLUDE INDUSTRY. A DRAFT REGULATION IS PROVIDED IN APPENDIX 11. NOW, BEFORE YOU MAKE UP YOUR MINDS ON THIS PROPOSAL PLEASE CONSIDER THE FOLLOWING:

THE APPROVAL REQUIREMENTS FOR ESTABLISHING WASTE FACILITIES UNDER PART V OF THE EPA HAVE IN PRACTICE BEGUN TO PARALLEL THE REQUIREMENTS OF THE EAA.

GUIDELINES WILL BE DEVELOPED TO PROVIDE BETTER DIRECTION TO ALL THOSE INVOLVED IN SATISFYING MINISTRY REQUIREMENTS FOR THE ENVIRONMENTAL ASSESSMENT PROCESS, INCLUDING TECHNICAL REQUIREMENTS.

WE DON'T THINK SMALL SITES WITH INSIGNIFICANT ENVIRONMENTAL IMPACTS SHOULD REQUIRE EXPENSIVE AND LENGTHY APPROVAL HEARINGS.

WHAT DO I MEAN BY SMALL?

THAT'S STILL TO BE DETERMINED. WE SUGGEST THAT A SMALL SITE WOULD BE ONE WITH A TOTAL LIFETIME CAPACITY OF NO MORE THAN 100,000 TONNES. THIS WOULD REPRESENT THE MUNICIPAL WASTE GENERATED BY AN AVERAGE COMMUNITY OF ABOUT 7,000 PEOPLE OVER A 20-YEAR PERIOD.

WE ARE ALSO CONSIDERING TWO ALTERNATIVE WAYS TO DEAL WITH SUCH SMALL SITES.

ONE WOULD KEEP A SMALL SITE UNDER THE ENVIRONMENTAL PROTECTION ACT WITH THE NECESSITY FOR PUBLIC HEARINGS AT THE DISCRETION OF THE MINISTRY.

THE OTHER ALTERNATIVE WOULD BE THE PREPARATION OF A **CLASS ENVIRONMENTAL ASSESSMENT**; AN ASSESSMENT OF A GROUP OF FACILITIES OR SITES OF THE SAME TYPE. SUCH SITES, HOWEVER, COULD STILL BE SUBJECT TO PUBLIC HEARINGS.

THE MINISTRY ALSO SUGGESTS THAT OTHER DISPOSAL FACILITIES ALSO BE EXEMPT FROM THE ENVIRONMENTAL ASSESSMENT ACT. THEY WOULD, HOWEVER, REQUIRE CERTIFICATES OF APPROVAL UNDER THE ENVIRONMENTAL PROTECTION ACT.

INCLUDED ON THIS LIST WOULD BE SITES WHICH UTILIZE, STORE OR DISPOSE OF PROCESSED ORGANIC WASTE, AND OPEN TRANSFER STATIONS WHICH DO NOT ACCEPT SPECIAL WASTE.

TO ASSIST IN THE ESTABLISHMENT OF THE CONDITIONS, UNDER WHICH INDUSTRY SHOULD COME UNDER THE EAA, WE ARE PROPOSING TWO CLASSES OF PRIVATE INDUSTRIAL FACILITIES.

CLASS 1 FACILITIES ARE LOCATED ON COMPANY PROPERTY AND DEAL WITH ONLY CONTROLLED AND MUNICIPAL WASTE GENERATED ON THE PROPERTY.

WE PROPOSE THAT THEY CONTINUE TO COME UNDER PART V OF THE ENVIRONMENTAL PROTECTION ACT.

CLASS 2 FACILITIES HANDLE ALL CATEGORIES OF WASTE PRODUCED EITHER ON COMPANY PROPERTY OR PRODUCED FROM ONE OR MORE OTHER OFF-SITE PLANTS UNDER COMMON OWNERSHIP. WE PROPOSE THAT THEY BE SUBJECT TO THE SAME ENVIRONMENTAL ASSESSMENT ACT APPROVAL PROCESS REQUIRED FOR MUNICIPAL FACILITIES.

PERPETUAL CARE: PROTECTION FOR THE FUTURE

WHEN I'M DONE SPEAKING -- AND AFTER THE COFFEE BREAK, OF COURSE -- BILL BALFOUR, MANAGER OF THE MUNICIPAL SECTION OF THE WASTE MANAGEMENT BRANCH, WILL TELL YOU EVERYTHING YOU EVER WANTED TO KNOW ABOUT PERPETUAL CARE.

AND THAT'S ABOUT IT. BUT NOT QUITE.

TRANSITIONAL REQUIREMENTS

THE CHANGES PROPOSED IN THE BLUEPRINT COULD NOT BE IMPLEMENTED OVERNIGHT. THAT WOULD BE IMPOSSIBLE.

THERE WILL HAVE TO BE A PERIOD OF TRANSITION.

AFTER THE PROMULGATION OF A GENERATOR REGISTRATION REGULATION, FOR EXAMPLE, THERE WOULD BE A 12 TO 18 MONTH PHASE-IN PERIOD.

CARRIERS OF SPECIAL WASTES, FOR ANOTHER EXAMPLE, WOULD HAVE TO BE GIVEN A CERTAIN PERIOD OF TIME TO APPLY FOR CERTIFICATES OF APPROVAL WHICH WILL BE REQUIRED UNDER NEW LEGISLATION. YOU WILL FIND OUR SUGGESTIONS ON THIS IN THE BLUEPRINT.

THE REQUIREMENT DURING THE TRANSITION PERIOD IS ANOTHER TOPIC -- ANOTHER SERIES OF TOPICS -- WE HOPE TO TALK TO YOU ABOUT OVER THE NEXT FIVE MONTHS.

BUT JUST HOW ARE WE GOING TO TALK? WHEN ARE WE GOING TO TALK?

THE ROAD TO EFFECTIVE WASTE MANAGEMENT

WE'VE BEEN TAKING SUGGESTIONS AND SUBMISSIONS FOR THE BLUEPRINT SINCE THE MINISTER FIRST ANNOUNCED IT LAST NOVEMBER.

NOW THAT IT'S BEEN PUBLISHED, YOU'LL HAVE SEVERAL MONTHS TO STUDY IT, TALK ABOUT IT, REACT TO IT -- RESPOND TO IT.

THIS FALL, WE'LL HOLD A SERIES OF PUBLIC MEETINGS ACROSS THE PROVINCE TO GET MORE SUBMISSIONS AND REACTIONS AND TO JUST TALK ABOUT IT -- IN EITHER SPECIFIC OR GENERAL TERMS, DEPENDING UPON THE AUDIENCE AND WHAT THEY'RE INTERESTED IN.

WE'RE WILLING TO MEET WITH YOU, AT YOUR CONVENIENCE, TO DISCUSS EVERY ASPECT OF THE BLUEPRINT.

AND AFTER WE'VE HAD OUR PUBLILC MEETINGS AND CONFERENCES, WE WILL PREPARE THE FINAL VERSION.

IMPLEMENTATION OF THE CHANGES OUTLINED IN THE FINAL BLUEPRINT WILL BEGIN IN EARLY 1984.

THAT FINAL BLUEPRINT MUST BE -- AND WILL BE -- A WORKABLE DOCUMENT, ONE OFFERING A WORKABLE SYSTEM.

WE IN THE MINISTRY CAN MAKE YOU TWO PROMISES ABOUT IT.

FIRST, WE PROMISE THAT IT WILL NOT MAKE EVERYONE HAPPY. IT WILL NOT PLEASE EVERYONE.

BUT SECOND, WE ALSO PROMISE THAT IT WILL BE THE RESULT OF LISTENING TO EVERYONE AND SERIOUSLY STUDYING AND CONSIDERING WHAT THEY -- WHAT YOU -- SUGGEST.

IN CLOSING, I WANT TO READ SOMETHING TO YOU. DON'T WORRY, IT'S NOT LONG.

IT'S A PARAGRAPH IN THE MINISTER'S INTRODUCTION TO THE BLUEPRINT. IT SUMS UP THE ENTIRE PROCESS. HE SAYS, AND I QUOTE:

> "TO BE SUCCESSFUL, ANY WASTE MANAGEMENT PROGRAM MUST HAVE THE CO-OPERATION, SUPPORT **AND PARTICIPATION** OF MUNICIPAL GOVERNMENTS, INDUSTRY, AND, MOST IMPORTANT, THE GENERAL PUBLIC. INDEED, THE VERY FORMULATION OF A MASTER PLAN FOR WASTE MANAGEMENT MUST TAKE INTO ACCOUNT THE VIEWS AND CONCERNS OF AS MANY PEOPLE IN ONTARIO AS POSSIBLE."

THAT'S THE END OF THE QUOTE, LADIES AND GENTLEMEN. IT'S ALSO THE END OF MY SPEECH.

PERPETUAL CARE

BY

WILLIAM R. BALFOUR

MANAGER, MUNICIPAL SECTION

WASTE MANAGEMENT BRANCH

ONTARIO MINISTRY OF THE ENVIRONMENT

THE MINISTER AND TOM ARMSTRONG HAVE GIVEN YOU THE HIGHLIGHTS, AND A COMPREHENSIVE OVERVIEW OF ONTARIO'S NEW BLUEPRINT FOR WASTE MANAGEMENT.

NOW IT'S TIME FOR THE NITTY GRITTY.

ACTUALLY, IN THIS CASE, I SHOULD SAY IT'S TIME FOR THE GRITTY NITTY.

WHY? TWO REASONS.

FIRST, THERE ARE FEW THINGS GRITTIER THAN A WASTE DISPOSAL SITE.

SECOND, WE ARE GOING TO BE REAL NIT PICKERS ABOUT HOW THOSE SITES ARE ESTABLISHED, OPERATED AND CARED FOR.

MY TALK THIS MORNING DEALS WITH CARE -- PERPETUAL CARE.

MOST OF YOU ARE FAMILIAR WITH THE CONCEPT. PERPETUAL CARE IS AN IDEA WHICH HAS BEEN AROUND FOR SOME TIME. I'M SURE MANY OF YOU REMEMBER THAT THE MOE TASK FORCE REPORT WAS PUBLISHED IN 1979, AND THAT IT COVERED THE NEEDS AND SOME OF THE COMPONENTS OF THE PROGRAM.

BUT THAT WAS ABOUT IT. THERE WASN'T MUCH OTHER ACTION TAKEN ABOUT PERPETUAL CARE UNTIL WE STARTED PREPARING THE BLUEPRINT LAST YEAR. WE LOOKED AT A LOT OF IDEAS AND CONCEPTS THEN. AND WE LOOKED AT THEM MORE THAN ONCE.

THE BLUEPRINT IS DESIGNED TO FIT <u>OUR</u> ENVIRONMENTAL NEEDS.

WE -- YOU, AND I, OUR FAMILIES, OUR CHILDREN AND OUR GRANDCHILDREN -- WE ALL HAVE A RIGHT TO LIVE IN THE BEST ENVIRONMENT POSSIBLE.

COUPLED WITH THAT RIGHT IS THE RESPONSIBILITY TO KEEP AND MAKE THE ENVIRONMENT THE BEST ONE POSSIBLE.

PERPETUAL CARE WILL HELP US DO THE JOB. THAT'S WHY IT'S A MAJOR COMPONENT OF THE BLUEPRINT.

NOW LET'S LOOK AT IT IN DETAIL.

SLIDE 1

FIRST, IN TERMS OF THE BLUEPRINT, JUST WHAT DOES THE TERM PERPETUAL CARE REALLY MEAN?

WHAT WE'RE TALKING ABOUT IS A COMPREHENSIVE PROGRAM OF FINANCIAL ASSURANCES.

THERE MUST BE MONEY AVAILABLE. THAT MONEY MIGHT HAVE TO BE USED TO CARRY OUT NECESSARY REMEDIAL ACTION, OR IT MIGHT HAVE TO BE USED FOR COMPENSATION FOR DAMAGE RESULTING FROM THE DISPOSAL-- THE STORAGE -- OF WASTE.

BUT WHO'S RESPONSIBLE? WHO PAYS? WHERE'S THE MONEY TO COME FROM?

FROM THE USERS -- FROM THE PEOPLE AND COMPANIES WHICH USE A WASTE SITE.

A MUNICIPALITY USING A SITE MUST PAY ITS SHARE OF THE COST OF OPERATING AND MAINTAINING A WASTE DISPOSAL SITE. IT'S PART OF THE PRICE -- AND RESPONSIBILITY -- OF SERVING THE PUBLIC.

A COMPANY USING A SITE MUST PAY ITS SHARE OF THE COST OF OPERATING AND MAINTAINING A WASTE DISPOSAL SITE. IT'S PART OF THE PRICE -- AND RESPONSIBILITY -- OF DOING BUSINESS.

BUT HOW IS PAYMENT MADE? HOW CAN THE PUBLIC -- YOU AND I AND OUR CHILDREN -- BE ASSURED THAT THE PRICE WILL BE PAID; THAT MONEY WILL BE AVAILABLE TO MEET FUTURE, AND POSSIBLY UNFORESEEN, NEEDS?

AS SPELLED OUT IN THE BLUEPRINT, THE PROGRAM CALLS FOR THREE TYPES OF GUARANTEES. I WILL GO INTO THEM IN MORE DETAIL IN A FEW MINUTES, BUT THEY ARE:

1] FINANCIAL GUARANTEES,

2] ENVIRONMENTAL IMPAIRMENT INSURANCE, AND

3] THE WASTE MANAGEMENT SECURITY FUND.

SLIDE 2

NOW WHERE SHOULD THE PRINCIPLE OF PERPETUAL CARE BE APPLIED?

THERE ARE MANY OPTIONS AVAILABLE. WE WILL CONSIDER ALL OF THEM. TO MAKE SURE WE DO, AND TO MAKE SURE WE DON'T MISS ANY, WE WANT YOUR OPINIONS, AND ANY OPTIONS YOU MIGHT LIKE TO SUGGEST.

THERE ARE A LOT OF WASTE DISPOSAL SITES, AND THEY HANDLE A LOT OF DIFFERENT TYPES OF WASTE. SOME OF IT IS OBVIOUSLY OF THE SORT WHICH WILL REQUIRE PERPETUAL CARE -- PERPETUAL MONITORING. OTHER TYPES -- MUNICIPAL SEWAGE SLUDGE IS JUST ONE EXAMPLE -- MIGHT NOT REQUIRE AS MUCH.

AND A SITE HANDLING NORMAL MUNICIPAL WASTE IS NOT THE SAME AS A SITE HANDLING MORE POTENTIALLY PROBLEMATICAL TYPES OF WASTE.

WE INTEND TO STUDY THE ENTIRE RANGE OF POSSIBILITIES. WE'LL STUDY ALL THE COMBINATIONS AND PERMUTATIONS WHICH MIGHT OCCUR.

WE'LL PROBABLY EVEN WIND UP STUDYING COMBINATIONS AND PERMUTATIONS WHICH CAN'T OCCUR -- AT LEAST WE HOPE THEY WON'T.

WE ALSO INTEND TO STUDY THE COST.

SLIDE 3

SO, LET'S GO BACK TO THE VARIOUS TYPES OF FINANCIAL GUARANTEES I MENTIONED EARLIER.

FINANCIAL GUARANTEES WILL BE REQUIRED FOR EVERY STAGE OF THE ACTIVE LIFE OF AN OPERATING OR PROPOSED WASTE SITE.

THEY WOULD COVER THE ESSENTIALS OF ONSITE DEVELOPMENT OPERATIONS. I'M TALKING ABOUT GAS AND LEACHATE MONITORING, CONTROL, COLLECTION, TREATMENT AND DISPOSAL SYSTEMS.

I'M ALSO TALKING ABOUT THE COST OF CLOSING THE SITE; SUCH AS THE COSTS OF APPLYING THE FINAL GROUND COVER, LANDSCAPING AND POST-CLOSURE MONITORING.

HOW BIG SHOULD THOSE GUARANTEES BE?

SOME SAY THEY JUST HAVE TO BE LARGE ENOUGH TO COVER THE DEDUCTIBLE PORTION OF THE INSURANCE POLICY -- LIKE THE $50 DEDUCTIBLE COLLISION INSURANCE ON YOUR CAR.

THERE'S ALSO A GOOD CASE TO BE MADE FOR THOSE WHO WANT THEM LARGE ENOUGH TO COVER MAJOR ONSITE CONTINGENCIES BECAUSE ENVIRONMENTAL IMPAIRMENT INSURANCE MIGHT NOT COVER THEM.

WHATEVER THE AMOUNT, THE FINANCIAL GUARANTEES COULD BE PROVIDED IN ONE OF TWO WAYS:

1] BUILT UP OVER THE ACTIVE LIFE OF A SITE ON A SCHEDULE KEYED TO LIKELY NEED; OR

2] POSTED UPFRONT, IN THE FORM OF A SURETY OR BOND.

IN THE BLUEPRINT, WE SUGGEST THAT FINANCIAL GUARANTEES BE MANDATORY FOR PRIVATE WASTE COMPANIES AND INDUSTRIAL SITES.

THE ACTUAL AMOUNT OF ANY GUARANTEE WOULD HAVE TO BE DETERMINED ON A CASE-BY-CASE BASIS, AND WOULD FORM A PART OF THE SITE-APPROVAL PROCESS.

AS FAR AS MUNICIPALITIES ARE CONCERNED, THERE IS A GOOD ARGUMENT TO BE MADE FOR THOSE WHO SAY THAT MUNICIPALITIES NEED NOT POST A BOND.

THEY SUGGEST, INSTEAD, THAT WHEN A MUNICIPALITY APPLIES FOR A CERTIFICATE OF APPROVAL FOR A PROPOSED SITE -- AND DEFENDS THAT APPLICATION AT A HEARING -- THAT IT PROVE IT CAN COME UP WITH NECESSARY FUNDS AS REQUIRED.

AS I SAID, THERE ARE OPTIONS TO BE STUDIED. BUT THE BASIC PRINCIPLE CALLS FOR HAVING SOME FORM OF FINANCIAL GUARANTEE IN PLACE EITHER WHEN YOU APPLY FOR A CERTIFICATE OF APPROVAL, OR AS A FINAL REQUIREMENT BEFORE THAT CERTIFICATE WILL ACTUALLY BE ISSUED.

THE GUARANTEES SHOULD ALSO HAVE TO BE IN PLACE UNTIL THE END OF THE SO-CALLED POST-CLOSURE PERIOD.

THE LENGTH OF THAT PERIOD WILL BE DEFINED LATER.

SLIDE 4

ONE WAY OF PROVIDING GUARANTEES IS THROUGH ENVIRONMENTAL IMPAIRMENT INSURANCE. IT IS AVAILABLE IN ONTARIO, BUT IT ISN'T USED MUCH.

IT IS, ESSENTIALLY, A COMPREHENSIVE POLICY COVERING PERSONAL INJURY, PROPERTY DAMAGE, IMPAIRMENT OR ANY OTHER INTERFERENCE WITH ANY ENVIRONMENTAL RIGHT PROTECTED BY LAW -- AND OFF-SITE OCCURRENCES CAUSED BY ONSITE CONDITIONS.

ITS BASIC PURPOSE IS TO ENSURE THAT WASTE SITE OWNERS AND OPERATORS ARE ABLE TO RESPOND TO CLAIMS FOR ENVIRONMENTAL OR HEALTH DAMAGES.

IT MAY, FOR EXAMPLE, COVER AN ONSITE OCCURRENCE REQUIRING ACTION TO PREVENT A CONTINUING OFF-SITE POLLUTION PROBLEM.

BUT EVEN WITH ENVIRONMENT IMPAIRMENT INSURANCE, THERE WILL BE A NEED FOR OTHER FORMS OF CASH GUARANTEES TO COVER GAPS IN THE POLICY'S COVERAGE.

THERE ARE OPTIONS AND ALTERNATIVES FOR PLACING INSURANCE.

ALL OWNERS AND OPERATORS COULD BE REQUIRED TO HAVE INDIVIDUAL ENVIRONMENTAL INSURANCE -- PRIVATE COMPANIES AND MUNICIPALITIES ALIKE.

GROUP POLICIES ARE ANOTHER SUGGESTION.

REGIONAL OR COUNTY GOVERNMENTS MIGHT TAKE OVER THE ADMINISTRATIVE DUTIES OF HANDLING A GROUP POLICY FOR ALL THE MUNICIPALITIES IN THEIR AREAS.

SOME LARGE MUNICIPALITIES THAT MIGHT FEEL THAT THEIR FINANCIAL BASE IS LARGE ENOUGH TO COVER ALL RISKS MIGHT DECIDE TO SELF-INSURE.

OF COURSE A MUNICIPALITY -- OR CORPORATION -- WANTING TO DO THAT WOULD HAVE TO SHOW THAT IT ACTUALLY COULD HANDLE THE POTENTIAL FINANCIAL LIABILITY.

SOME PEOPLE HAVE SUGGESTED THAT THE PROVINCIAL GOVERNMENT TAKE OUT A SINGLE INSURANCE POLICY FOR ALL THE SITE OWNERS AND OPERATORS IN ONTARIO.

WHILE THAT WOULD OFFER ADVANTAGES IN TERMS OF ADMINISTRATION, SIMPLIFICATION OF REGULATORY REQUIREMENTS AND POSSIBLY SOME COST ADVANTAGES, IT COULD ALSO CAUSE SOME DISADVANTAGES.

IT COULD REDUCE THE AMOUNT OF FREE ENTERPRISE IN THE BUSINESS AND, POSSIBLY EVEN MORE IMPORTANT THAN THAT, REMOVE SOME OF THE INCENTIVES AN INDIVIDUAL OPERATOR MIGHT HAVE TO RUN A SITE AT THE HIGHEST ENVIRONMENTAL LEVEL POSSIBLE.

MINISTRY STAFFERS CURRENTLY FAVOR REQUIRING INDIVIDUAL ENVIRONMENTAL IMPAIRMENT POLICIES FOR SPECIFIED SITES -- PRIVATE, MUNICIPAL AND INDUSTRIAL.

WE ALSO BELIEVE THAT THE INSURANCE SHOULD BE IN PLACE BEFORE THE FIRST LOAD OF WASTE IS RECEIVED AND LAST UNTIL AT LEAST THE END OF THE SO-CALLED POST-CLOSURE PHASE.

AS FAR AS THE SIZE OF THE POLICIES; OUR INVESTIGATIONS SUGGEST THAT FOR MUNICIPAL SITES, THE AMOUNTS BE RELATED TO THE SIZE OF THE MUNICIPALITY; WHILE FOR PRIVATE AND INDUSTRIAL SITES, IT BE ESTABLISHED ON A CASE-BY-CASE BASIS.

IN EITHER CASE, THE POLICIES WOULD LIKELY BE FOR SEVERAL MILLION DOLLARS.

AGAIN IN EITHER CASE, THE SIZE OF THE DEDUCTIBLE MUST CLEARLY REFLECT THE FINANCIAL POSITION OF THE INSURED AND THE EXTENT OF THE RISK THAT THE OWNER-OPERATOR IS PREPARED TO ASSUME OR TO SELF-INSURE.

BUT, AS WITH THE REST OF THE BLUEPRINT, WE'RE LOOKING FOR YOUR SUGGESTIONS AND FEEDBACK.

SLIDE 5

THE THIRD AND FINAL FINANCIAL ASPECT IS THE WASTE MANAGEMENT SECURITY FUND. IN THE ORIGINAL TASK FORCE REPORT IT WAS CALLED THE PERPETUAL CARE FUND.

IT IS, IN EFFECT, AN ESCROW ACCOUNT -- AN EMERGENCY FUND.

THE MONEY IS THERE -- UNDER PROVINCIAL CONTROL -- AND IT IS TO BE USED UNDER CLEARLY DEFINED CIRCUMSTANCES.

THE PURPOSE OF THE MONEY IS TO ENSURE THAT ENVIRONMENTAL PROBLEMS ARE **QUICKLY** HANDLED. THE EMPHASIS, IN THIS CASE, IS ON THE WORD **QUICKLY**.

DURING THE ACTIVE OR POST-CLOSURE LIFE OF A SITE, IT WOULD BE CALLED UPON ONLY UNDER EMERGENCY CONDITIONS WHERE:

1] THERE WAS A GAP IN THE NORMAL COVERAGE; OR

2] WHERE A PAYMENT WAS SLOW IN BEING MADE; OR

3] WHERE THE RESPONSIBILITY FOR MAKING THE PAYMENT WAS BEING CHALLENGED IN COURT.

IN ANY EVENT, THE WASTE MANAGEMENT SECURITY FUND WILL RECOVER ANY MONEY IT SPENDS DURING AN EMERGENCY FROM THE OWNER-OPERATORS, INSURANCE COMPANIES, OR WHOEVER ELSE IS RESPONSIBLE FOR THE PROBLEM -- THROUGH COURT ACTION, IF NECESSARY.

THAT'S DURING THE ACTIVE AND POST-CLOSURE LIFE OF A SITE. AFTER POST-CLOSURE, THE FUND WOULD COVER ANY AND ALL REMEDIAL WORK FOR COMPENSATION FOR ALL ENVIRONMENTAL HAPPENINGS.

NOW, WHERE IS THE MONEY FOR THAT FUND TO COME FROM?

AS I SAID EARLIER, THE TASK FORCE RECOMMENDED THE PHILOSOPHY OF USER PAYS.

INITIALLY, TO MAKE SURE THAT THE FUND HAS ENOUGH MONEY TO OPERATE, MONEY COULD BE BORROWED FROM LENDING INSTITUTIONS, OR THE PROVINCE COULD PROVIDE AN OPERATING CAPITOL BASE. BUT AS FUNDS STARTED COMING IN, THE LOAN WOULD BE REPAID, WITH INTEREST.

WE FEEL THAT ALL SITES -- MUNICIPAL, INDUSTRIAL AND PRIVATE -- SHOULD CONTRIBUTE TO THE FUND ON THE BASIS OF A SURCHARGE ADDED TO THE NORMAL TIPPING FEE IT CHARGES.

SINCE THE FUND WOULD BE THERE TO DRAW UPON DURING THE ENTIRE LIFE OF A SITE, THAT SURCHARGE WOULD BE COLLECTED DURING THE ENTIRE WASTE RECEIVING LIFE OF THE SITE.

BUT HOW LARGE SHOULD THE FUND BE?

ANSWERING THAT QUESTION WILL REQUIRE A GREAT DEAL OF INFORMATION, THOUGHT AND DISCUSSION -- DISCUSSION WE HOPE YOU WILL PARTICIPATE IN. IN FACT, WE'RE COUNTING ON IT.

AND TO GET THE DISCUSSION STARTED, WE ARE PROPOSING THAT A REASONABLY SIZED FUND WOULD BE ABOUT $30 MILLION -- AFTER 10 YEARS OF OPERATION.

THAT IS BASED ON THE ASSUMPTIONS THAT INTEREST PAYMENTS AND PAYOUTS WOULD BALANCE EACH OTHER OUT, ROUGHLY, AND THAT THERE WOULD BE NO HORRENDOUS EVENT WHICH WOULD DEPLETE THE FUND.

TO FINANCE SUCH A FUND, SURCHARGES ON TIPPING FEES OF -- FOR EXAMPLE -- 30 CENTS PER TONNE OF DOMESTIC WASTE AND $3 PER TONNE FOR HAULED LIQUID INDUSTRIAL AND HAZARDOUS INDUSTRIAL WASTES WOULD GENERATE $30 MILLION IN 10 YEARS.

AS I SAID, THESE FIGURES ARE TO BE CONSIDERED AS A STARTING POINT.

WE WANT YOUR REACTIONS AND IDEAS.

AFTER ALL, WE ARE ALL IN THIS TOGETHER -- THE PROVINCE, MUNICIPALITIES, INDUSTRY AND THE PUBLIC WE SERVE.

AS I SAID BEFORE -- AND IT CAN'T BE SAID ENOUGH -- THIS IS ONLY A TENTATIVE OUTLINE OF THE MAJOR COMPONENTS OF THE PROPOSED PERPETUAL CARE PROGRAM.

BUT EVEN THOUGH THERE ARE A NUMBER OF OPTIONS AVAILABLE -- OPTIONS WHICH WILL BE HASHED AND REHASHED OVER THE NEXT FIVE MONTHS -- WHAT FOLLOWS IS A REASONABLE POINT TO BEGIN THE DISCUSSION.

SLIDE 6

WE IN THE MINISTRY THINK THE PROGRAM SHOULD APPLY TO SPECIFIED WASTE MANAGEMENT FACILITIES -- PROVINCIAL, MUNICIPAL AND PRIVATELY OWNED AND OPERATED -- BOTH ACTIVE AND CLOSED.

WE ALSO PROPOSE THAT ONCE THE INITIAL PROGRAM HAS BEEN ESTABLISHED AND OUR EXPERIENCES HELP US DEVELOP THE NECESSARY EXPERTISE, WE SHOULD TAKE ANOTHER LOOK AT THE PROGRAM AND DISCUSS ADDITIONAL TYPES OF WASTE FACILITIES THAT SHOULD BE ADDED TO THE PROGRAM.

AS OF NOW, WE THINK THAT IT'S REASONABLE TO ALLOW OWNERS AND OPERATORS TO CHOOSE WHAT SORT OF FINANCIAL GUARANTEES THEY WANT TO MAKE; EITHER BONDS OR CASH IN TRUST.

THE ACTUAL MIX OF SELF-INSURANCE, FINANCIAL GUARANTEES AND ENVIRONMENTAL IMPAIRMENT INSURANCE COVERAGE THAT AN OWNER-OPERATOR WANTS TO HAVE CAN ALSO BE LEFT TO THE INDIVIDUAL OWNER-OPERATORS TO DETERMINE.

SO CAN THE DECISION REGARDING TAKING OUT COMPLETE COVERAGE OR GENERAL LIABILITY INSURANCE PLUS ENVIRONMENTAL IMPAIRMENT INSURANCE AS SEPARATE POLICIES.

BUT CONDITIONS AND LIMITATIONS SHOULD BE ESTABLISHED AFTER THE NEXT FIVE MONTHS OF DISCUSSION CONCERNING MANDATORY LEVELS OF FINANCIAL GUARANTEES, ENVIRONMENT IMPAIRMENT INSURANCE AND CONTRIBUTIONS TO THE WASTE MANAGEMENT SECURITY FUND.

NOW SINCE ALL OF THIS CONCERNS WASTE DISPOSAL SITES, LET'S TAKE A LOOK NOW AT THEIR LIFE CYCLE.

SLIDE 7

THIS SLIDE OUTLINES THE FUNDAMENTAL STAGES IN THE LIFE CYCLE OF A WASTE FACILITY AND INDICATES THE DIFFERENT COMPONENTS OF THE PERPETUAL CARE PROGRAM AND THE STAGES TO WHICH THEY EACH COULD APPLY.

THERE ARE THREE STAGES.

FIRST IS THE PRE-CERTIFICATION STAGE. THIS GENERALLY COVERS EVERYTHING UP TO THE RECEIPT OF A CETIFICATE OF APPROVAL.

NEXT COMES THE ACTIVE STAGE. THIS COVERS SITE PREPARATION, RECEIVING AND DISPOSING OF THE WASTE. IT ALSO COVERS CLOSING DOWN A SITE.

FINALLY, THERE IS THE CLOSED STAGE. BUT, THERE ARE TWO ASPECTS TO THAT.

DURING THE POST-CLOSURE PHASE, THE SITE WILL BE MONITORED TO MAKE SURE NO ENVIRONMENTAL OR HEALTH PROBLEMS DEVELOP.

THIS COULD LAST FOR YEARS. IT WILL LAST UNTIL THE MINISTRY IS CONVINCED -- BY THE OWNER-OPERATOR AND THROUGH MONITORING AND TESTING THE SITE -- THAT NO SERIOUS LONG-TERM PROBLEMS ARE LIKELY TO EVER OCCUR.

AT THAT TIME, A POST-CLOSURE DOCUMENT WILL BE ISSUED. THE OWNER-OPERATOR CAN RECOVER THE FINANCIAL GUARANTEES AND CANCEL THE INSURANCE POLICY.

AT THAT POINT THE WASTE MANAGEMENT SECURITY FUND ASSUMES ALL ENVIRONMENTAL RESPONSIBILITIES FOR THE SITE, PROVIDING -- OF COURSE -- THAT THE OWNER OR OPERATOR HAS HONESTLY MET ALL ESTABLISHED CONDITIONS AND REQUIREMENTS.

ANY QUESTION OF NEGLIGENCE OR FRAUD THAT AROSE AT A LATER DATE WOULD HAVE TO BE SETTLED BY THE COURTS.

THOSE ARE THE STAGES.

THE REST OF THE SLIDE SHOWS A POSSIBLE MIX OF THE THREE FINANCIAL COMPONENTS.

DON'T FORGET. THESE ARE PROPOSALS. WE HAVE FIVE MONTHS TO TALK ABOUT THEM. THERE ARE MANY PERMUTATIONS AND COMBINATIONS. HERE ARE ONLY A FEW EXAMPLES.

1] ENVIRONMENT LIABILITY INSURANCE COULD BE REQUIRED IN BOTH MUNICIPAL AND PRIVATE OPERATIONS, FROM THE BEGINNING OF THE SITE'S ACTIVE LIFE TO THE END OF THE POST-CLOSURE STAGE.

2] FINANCIAL GUARANTEES -- IN THE FORM OF CASH OR BONDS -- COULD BE REQUIRED FROM PRIVATE SITES FOR THE SAME PERIOD THAT ENVIRONMENT IMPAIRMENT INSURANCE WOULD BE REQUIRED.

3] THE WASTE MANAGEMENT SECURITY FUND COULD BE AVAILABLE ON AN EMERGENCY BASIS DURING THE ACTIVE AND POST-CLOSURE STAGE OF THE SITE, AND, ONCE CLOSED, WOULD THEN ASSUME RESPONSIBILITY FOR PERPETUITY.

SLIDE 8

SO MUCH FOR THE PROGRAM.

NOW, LET'S TALK ABOUT HOW WE ARE GOING TO GET IT GOING.

FIRST OFF, IT WILL TAKE A LOT OF WORK -- ON THE PART OF THE MINISTRY, THE MUNICIPALITIES AND THE PRIVATE SECTOR.

LEGISLATIVE CHANGES WILL HAVE TO BE MADE; REGULATIONS WILL HAVE TO BE WRITTEN; AND GUIDELINES MUST BE DEVELOPED.

PROCEDURES HAVE TO BE PUT IN PLACE FOR THE FINANCIAL GUARANTEES AND FOR THE ADMINISTRATION AND OPERATION OF THE WASTE MANAGEMENT SECURITY FUND.

PHASING IN PERPETUAL CARE WILL TAKE CONSIDERABLE THOUGHT.

INITIALLY, FOR EXAMPLE, IT COULD APPLY TO ALL NEW SITES. THEN, THOSE SITES CURRENTLY ACTIVE OR STILL IN THEIR POST-CLOSURE PHASE COULD BE BROUGHT IN. FINALLY, ALL THE CLOSED SITES IN THE PROVINCE COULD BE INCLUDED.

SLIDE 9

AND THAT, LADIES AND GENTLEMEN, PRETTY WELL WRAPS IT UP -- THE NITTY AND THE GRITTY.

THERE IS MORE INFORMATION -- IF ANY OF YOU REALLY WANT MORE INFORMATION AT THIS POINT -- IN APPENDIX 3 OF THE BLUEPRINT.

JUST ONE MORE POINT.

THIS IS A DRAFT PROPOSAL. AS YOU LOOK THROUGH THE BLUEPRINT, AND THE APPENDICES, YOU WILL NOTE MUCH REMAINS TO BE DONE.

AND IT WILL BE.

SO, SPEAKING FOR MYSELF AS WELL AS FOR THE MINISTRY, I JUST WANT TO SAY THAT I HOPE THAT ALL OF YOU DO GET INVOLVED.

WE WANT TO MEET YOU, TALK TO YOU, HEAR YOUR IDEAS. THAT'S WHAT WE'RE HERE FOR. THAT'S ALSO WHY WE'LL BE AVAILABLE FOR MEETINGS AND PRESENTATIONS.

AFTER ALL, YOU'RE GOING TO BE LIVING WITH THIS PROGRAM FOR A LONG TIME TO COME.

SO YOU MIGHT AS WELL DO WHAT YOU CAN TO MAKE SURE YOUR CONCERNS AND INTERESTS ARE REPRESENTED.

PROPOSED REGULATIONS: HAZARDOUS WASTE DEFINITION - GENERATOR REGISTRATION - WAYBILLS

BY

BORIS BOYKO

MANAGER, INDUSTRIAL SECTION

WASTE MANAGEMENT BRANCH

ONTARIO MINISTRY OF THE ENVIRONMENT

WELL, SO FAR YOU'VE HEARD THE MINISTER ANNOUNCE THE BLUEPRINT'S HIGHLIGHTS. TOM ARMSTRONG FILLED IN THE DETAILS -- TO GIVE YOU A BROAD AND COMPREHENSIVE OVERVIEW -- AND BILL BALFOUR TOLD YOU ABOUT PERPETUAL CARE AND HOW THE FINANCIAL SIDE OF IT WOULD WORK.

YOU'VE EVEN HAD A CHANCE FOR A CUP OF COFFEE OR TWO.

ALL IN ALL, YOU'VE HAD A VERY BUSY MORNING.

SO IT'S ONLY FAIR, NOW, TO BRING ON THE FUN PART OF THE SHOW -- ME.
AND THE FUN SUBJECT -- **SPECIAL** WASTES.

SO AS I TALK TO YOU ABOUT LIQUID INDUSTRIAL AND HAZARDOUS WASTES, ABOUT MOVING THEM AND MONITORING THEM, AND ABOUT TOXICITY, I WANT YOU TO KEEP ONE THOUGHT IN MIND -- LUNCH.

YOU'LL BE ABLE TO HAVE IT AS SOON AS I'M FINISHED.

I HOPE YOU ENJOY IT.

AS MANY OF YOU KNOW, CURRENT CONTROL AND REGULATORY EFFORTS FOCUS ON THE TRANSPORTATION OF HAZARDOUS WASTE AND ITS ULTIMATE DISPOSAL.

WE ARE NOW LOOKING, HOWEVER, AT A MAJOR CHANGE.

ONTARIO'S NEW PROPOSED HAZARDOUS WASTE MANAGEMENT PROGRAM IS BASED ON THE CONCEPT OF "CRADLE-TO-GRAVE" MONITORING.

WE INTEND TO WATCH IT, CAREFULLY, FROM THE MOMENT IT IS GENERATED, AS IT IS BEING TRANSPORTED, AND ALL THE WAY THROUGH THE PROCESS TO ITS ULTIMATE DISPOSAL.

THE BLUEPRINT FOR WASTE MANAGEMENT PROPOSES THAT WE CLOSE THE HAZARDOUS-WASTE-CARE CIRCLE BY ADDING THAT THIRD COMPONENT -- THAT WE WATCH IT FROM THE MOMENT IT IS GENERATED.

THIS WILL BE MADE POSSIBLE THROUGH THE INTRODUCTION OF THE GENERATOR REGISTRATION REGULATION. WE ALSO PROPOSE OTHER REGULATIONS AIMED AT SYSTEMS INVOLVED IN THE TRANSPORTATION OF BOTH LIQUID INDUSTRIAL AND HAZARDOUS WASTES.

NOW, PREVIOUS SPEAKERS HAVE ALREADY DEALT WITH PROPOSED CHANGES TO THE HEARINGS, CERTIFICATION, AND APPROVAL REQUIREMENTS FOR THE RECEIVERS OF THESE WASTES.

THE MONITORING SYSTEM THAT TIES THE ACTIVITIES OF THE GENERATORS, CARRIERS, AND RECEIVERS TOGETHER IS THE MINISTRY'S WAYBILL SYSTEM. IT IS DEFINED UNDER REGULATION 313.

THE BLUEPRINT FOR WASTE MANAGEMENT ALSO PROPOSES AMENDMENTS TO THIS PARTICULAR REGULATION WHICH I'LL TALK ABOUT IN MORE DETAIL IN A FEW MINUTES.

RIGHT NOW, HOWEVER, I'D LIKE TO SPEND A FEW MOMENTS ON THE EMPHASIS BEING PLACED ON NEW FACILITIES FOR HAZARDOUS WASTE MANAGEMENT IN ONTARIO, FACILITIES WHICH WOULD BE UNDER THE ONTARIO WASTE MANAGEMENT CORPORATION.

BUT THERE ARE FACILITIES ALREADY IN OPERATION IN ONTARIO. THESE INCLUDE A COMMERCIAL SECURE LANDFILL AND LIQUID INDUSTRIAL WASTE INCINERATOR, NUMEROUS TRANSFER STATIONS AND RECYCLING AND RECOVERY OPERATIONS, AND ON-SITE DISPOSAL OR RECOVERY FACILITIES OFFERING EXCLUSIVE SERVICE TO WASTES GENERATORS.

GENERATOR REGISTRATION

IN LOOKING AT THE BLUEPRINT PROPOSALS AFFECTING THE INDUSTRIAL SECTOR, THE ONE THAT CLOSES THE "CRADLE-TO-GRAVE" MONITORING CYCLE IS THE PROPOSED GENERATOR REGISTRATION REGULATION.

THE REGULATION WOULD BE DESIGNED TO PROVIDE THE MINISTRY WITH INFORMATION FOR MONITORING AND WASTE CONTROL PURPOSES. IT WOULD NOT MERELY BE AUTHORIZING THE PRODUCTION OF ANY PARTICULAR WASTES.

THIS IS AN IMPORTANT CONCEPT AND I WOULD LIKE TO STRESS IT AGAIN.

THE INTENT IS TO ENSURE THAT THE GENERATOR IS AWARE OF ALL FACETS OF WASTE MANAGEMENT PERTINENT TO THE LIQIUD INDUSTRIAL AND HAZARDOUS WASTES THAT MAY BE PRODUCED.

THE REGULATION WOULD ALSO REQUIRE THE GENERATOR TO PROVIDE THE MINISTRY WITH THE FOLLOWING INFORMATION:

1] THE TYPES AND ESTIMATED QUANTITIES OF WASTES TO BE PRODUCED;

2] THE CLASSIFICATION OF WASTES, INCLUDING SUPPORTING ANALYTICAL DATA;

3] A GENERAL DESCRIPTION OF THE PROCESSES FROM WHICH THE WASTES ARISE;

4] DISPOSAL METHODS SUITABLE FOR THE PARTICULAR WASTES; AND

5] THE NAMES OF CARRIERS AND RECEIVERS INTENDED TO BE USED FOR THE MANAGEMENT OF THESE WASTES.

THIS REGISTRATION IS SEEN AS A ONE-TIME ONLY PROCEDURE. BUT FURTHER INFORMATION WOULD BE REQUIRED IF AND WHEN A GENERATOR PLANS OR MAKES SIGNIFICANT CHANGES IN WASTE TYPES OR QUANTITIES PRODUCED, OR WHEN NEW DISPOSAL PROCEDURES ARE CONTEMPLATED.

THE PROPOSED REGULATION HAS PROVISIONS FOR NON-ROUTINE PRODUCTION OF WASTES, EMERGENCY SITUATIONS AND SMALL QUANTITY EXEMPTIONS.

THE INFORMATION REQUIRED FOR REGISTRATION WOULD ALSO HELP FULFILL THE REQUIREMENTS OUTLINED IN THE FORTHCOMING DANGEROUS GOODS TRANSPORTATION ACT.

TRANSPORTATION

THE NEXT MAJOR ROLE IN THE POST-PRODUCTION MANAGEMENT OF SPECIAL WASTES IS THAT OF THE CARRIER, OR TRANSPORTATION SECTOR.

CURRENTLY, COMPANIES INVOLVED ONLY IN THE TRANSPORTATION OF SPECIAL WASTES ARE CERTIFIED IN ACCORDANCE WITH THE INFORMATION PROVIDED AT THE TIME OF APPLICATION FOR A CERTIFICATE OF APPROVAL.

THE BLUEPRINT PROPOSES ADDITIONAL STANDARDS FOR SUCH SYSTEMS. THESE INCLUDE VEHICLE STANDARDS, DRIVER TRAINING, PROVISION OF ADEQUATE DOCUMENTATION, COMPLIANCE WITH DGTA REQUIREMENTS, AND SOME FORM OF FINANCIAL GUARANTEE OR BOND TO PROVIDE FOR IMMEDIATE REMEDIAL ACTION IN THE EVENT OF ILLEGAL DEPOSIT OF WASTES.

THIS BOND OR GUARANTEE IS NOT DESIGNED TO SUPPLEMENT OR REPLACE ANY REQUIREMENTS UNDER THE SPILLS LEGISLATION, BUT TO ADDRESS SITUATIONS WHERE WASTES ARE ILLEGALLY STORED OR DEPOSITED AND IMMEDIATE REMEDIAL ACTION IS REQUIRED.

THE BLUEPRINT ALSO PROPOSES TO REINFORCE THE DISTINCTION BETWEEN WASTE SYSTEMS AND WASTE SITES. THE FORMER WOULD BE ONLY FOR THE TRANSPORTATION OF WASTES, AND NOT THE ESTABLISHMENT OF TRANSFER FACILITIES.

FACILITIES FOR TRANSFERRING SPECIAL WASTE WOULD HAVE TO BE APPROVED AND CERTIFIED IN A MUCH MORE RIGOROUS MANNER THAN FOR TRANSPORTATION SYSTEMS ALONE.

MANIFEST

AS INDICATED EARLIER, THE APPROACH USED FOR TYING TOGETHER ALL THE VARIOUS ACTIVITIES REQUIRED IN THE MANAGEMENT OF SPECIAL WASTES IS THE MINISTRY'S MANIFEST OR WAYBILL SYSTEM.

THIS SYSTEM WAS FIRST INTRODUCED ON A VOLUNTARY BASIS IN 1976.

SOME OF THE KEY REQUIREMENTS IN THE PRESENT REGULATION INCLUDE:

* COMPLETION AND DISTRIBUTION OF A FIVE PART FORM;

* THE 23 CATEGORY CLASSIFICATION SYSTEM;

* FLEXIBLE RETURN PERIOD;

* BROAD EXEMPTIONS FOR RECYCLED MATERIALS; AND

* EXCLUSION OF WASTES DESTINED FOR ON-SITE DISPOSAL.

IN KEEPING WITH THE NEED TO ADDRESS WASTE MANAGEMENT CONCERNS OF THE 1980S, AND TO PROVIDE FOR INCREASED ACCOUNTABILITY AND RESPONSIBILITY BY ALL PARTICIPANTS, THE BLUEPRINT FOR WASTE MANAGEMENT PROPOSES A NUMBER OF CHANGES TO THE MANIFESTING REQUIREMENTS.

HERE ARE SOME OF THE ONES BEING SUGGESTED:

* INTRODUCTION OF A SIXTH COPY OF THE WAYBILL FORM TO BE RETURNED TO THE GENERATOR BY THE RECEIVER;

* USE OF A UN CLASSIFICATION SYSTEM FOR HAZARDOUS WASTES AND AN EXPANDED LIQUID INDUSTIAL WASTE CLASSIFICATION SYSTEM;

* SHORTENING THE MANIFEST RETURN PERIOD TO THREE DAYS;

* PROVIDING ONLY VERY LIMITED RECYCLE EXEMPTIONS;

* RESPONSIBILITY OF THE GENRATOR TO TAKE BACK REFUSED LOADS; AND

* BROADENING THE APPLICATION OF THE MANIFEST SYTEM TO HAZARDOUS, LIQUID INDUSTRIAL AND SITE-SPECIFIC WASTES.

HAZARDOUS WASTE INTERPRETATION

BUT WHAT, EXACTLY, IS A HAZADOUS WASTE?

BECAUSE THE TERM "HAZARDOUS" IS PROBABLY SUJECT TO AS MANY INTERPRETATIONS AS THERE ARE PEOPLE WILLING TO GIVE ONE, THE MINISTRY FEELS IT IS NECESSARY TO HAVE AS OBJECTIVE, STRICT AND RIGOROUS A DEFINITION AS POSSIBLE.

YOU PROBABLY KNOW THAT THE PRESENT LEGAL DEFINITION OF HAZARDOUS WASTES -- UNDER REGULATION 309 -- CONSISTS OF A SIX LINE NARRATIVE FEATURING SOME PHRASES WHICH ARE OPEN TO BROAD INTERPRETATION; PHRASES LIKE "SPECIAL HANDLING", "FLAMMABILITY" AND "TOXICITY".

IT'S NO WONDER THAT THERE HAVE BEEN LEGAL PROBLEMS WITH: THE ACCEPTABILITY OF CERTAIN TYPES OF WASTES AT CERTIFIED DISPOSAL FACITLITIES; INCONSISTENT INTERPRETATIONS AND APPLICATIONS ACROSS THE PROVINCE; AND IN SOME CASES, MISUSE OF FACILITIES.

WE ARE AT A POINT WHERE A LANDFILL SITE THAT IS TECHNICALLY CAPABLE OF HANDLING SUCH MATERIALS IN AN ENVIRONMENTALLY ACCEPTABLE MANNER REFUSES IT BECAUSE THE MANAGER DOESN'T THINK HE'S ALLOWED TO.

THAT'S WHY THE BLUEPRINT FOR WASTE MANAGEMENT INCLUDES A PROPOSED "HAZARDOUS WASTE INTERPRETATION" THAT ATTEMPTS TO PROVIDE AS RIGOROUS AS POSSIBLE A DEFINITION OF WHAT IS TO BE CONSIDERED HAZARDOUS WASTE.

IT FEATURES A COMBINATION OF LISTING SPECIFIC CHEMICALS, CHEMICAL WASTES, AND WASTE STREAMS AS WELL AS PROVIDING A TESTING APPROACH FOR BROADER CLASSIFICATION OF HAZARDOUS WASTES.

THE PROPOSED INTERPRETATION INCLUDES:

* A GENERIC AND SPECIFIC WASTE STREAM LISTING;

* A LISTING OF CHEMICALS WITH THE PROPERTIES OF ACUTE TOXICITY;

* A LISTING OF CHEMICALS WITH CHRONIC TOXICITY PROPERTIES;

* A LISTING ADDRESSING VERY SPECIFIC CONTAMINANTS OF CONCERN;

* SEVERAL TESTING/NARRATIVE PROTOCOLS FOR BROAD CLASSIFICATION OF HAZARDOUS WASTES; AND

* AN APPROACH FOR ADDRESSING WASTES THAT ARE NOT INHERENTLY HAZARDOUS BUT CAN BE HANDLED BY APPROPRIATE DISPOSAL FACILITIES.

THIS PROPOSED INTERPRETATION IS SOMEWHAT SIMILAR TO THE HAZARDOUS WASTE DEFINITION FOUND IN THE RESOURCE CONSERVATION AND RECOVERY ACT OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY. IT IS ALSO SIMILAR TO THE APPROACH BEING TAKEN FOR DEFINITION OF HAZARDOUS WASTES UNDER THE TRANSPORTATION OF DANGEROUS GOODS ACT.

THE APPROACH ALSO OUTLINES SMALL QUANTITY EXEMPTIONS AND ALLOWS FOR A DELISTING PROCEDURE.

THAT'S THE PROGRAM IN A NUTSHELL.

BUT BEFORE I CLOSE AND WE MOVE INTO OUR QUESTION AND ANSWER SESSION, I'D LIKE TO COMMENT ON A NUMBER OF RELATED ISSUES AND CONCERNS.

ON THE WHOLE, INDUSTRY -- INCLUDING THE WASTE MANAGEMENT SECTOR -- HAS RECOGNIZED AND SUPPORTED THE CALL FOR GREATER INITIATIVES AND SHARED RESPONSIBILITY IN THE MANAGEMENT OF SPECIAL WASTES.

IN GENERAL, LARGE CORPORATIONS ARE AWARE OF THEIR RESPONSIBILITIES FOR PROPER ENVIRONMENTAL MANAGEMENT OF WASTES. THIS IS SHOWN BY THEIR GENERAL SUPPORT FOR PROPOSED REGULATIONS SUCH AS THESE AND THEIR HIGH LEVEL OF SUPPORT FOR THE ACTIVITIES OF THE ONTARIO WASTE MANAGEMENT CORPORATION.

BUT THERE ARE AREAS OF CONCERN. ONE IS THE LACK OF AWARENESS ON THE PART OF SMALLER GENERATORS. SOME OF THEM DON'T SEEM TO REALIZE THE INHERENT HAZARDS OF THE WASTES THEY PRODUCE, OR THE PROPER MANAGEMENT PROCEDURES REQUIRED FOR SUCH WASTES.

ANOTHER ISSUE THAT REQUIRES ATTENTION IS THE PUBLIC PERCEPTION OF LIQUID INDUSTRIAL WASTES.

MANY PAST INCIDENTS HAVE CONVINCED SOME SEGMENTS OF THE PUBLIC THAT ANY LIQUID WASTES BEING TRASPORTED IN A TANKER, OR IN DRUMS, ARE AUTOMATICALLY LIQUID INDUSTRIAL WASTES OF ENVIRONMENTAL CONCERN, AND, WITH A SLIGHT EXTENSION OF LOGIC, HAZARDOUS WASTES.

AS A RESULT, MANY INNOCUOUS LIQUID WASTES AND, IN SOME CASES, EVEN INERT LIQUIDS ARE REJECTED BY SANITARY LANDFILLS, EVEN THOUGH SUCH PRACTICES MAY PRESENT NO ENVIRONMENTAL PROBLEMS WHATSOEVER. IN FACT, THEY MIGHT PROVIDE THE BEST PRACTICAL DISPOSAL OPTION.

THIS THEN GIVES RISE TO THE THIRD ISSUE -- THE NEED FOR MUNICIPALITIES TO BE AWARE OF AND KNOW ABOUT THE VARIOUS WASTES PRODUCED WITHIN THEIR JURISDICTION. MUNICIPALITIES MUST ALSO ENSURE THAT THE REQUIRED PLANNING FOR THE MANAGEMENT OF SUCH WASTES IS CARRIED OUT.

WHERE SUCH WASTES CAN BE HANDLED AT MUNICIPAL FACILITIES IN AN ENVIRONMENTALLY SAFE AND ACCEPTABLE MANNER, THE MUNICIPALITY SHOULD CONSIDER IT THEIR RESPONSIBILITY TO ACCEPT SUCH WASTES FOR DISPOSAL.

THE KEY TO THIS PROBLEM, THIS THIRD ISSUE, IS EDUCATION.

WE NEED A THOROUGH, COMPREHENSIVE EDUCATION AND INFORMATION PROGRAM. AND WE NEED IT AIMED AT EVERYONE INVOLVED.

THIS INCLUDES WASTE GENERATORS, WASTE CARRIERS, AND WASTE RECEIVERS.

IT INCLUDES MUNICIPALITIES, INDUSTRY, AND GOVERNMENT.

IT ALSO INCLUDES THE PUBLIC.

THE BLUEPRINT FOR WASTE MANAGEMENT IS MORE THAN JUST A TECHNICAL PLAN. IT IS AN APPROACH, A PHILOSOPHICAL APPROACH TO ENVIRONMENTAL CONCERNS, ATTITUDES AND ACTIONS.

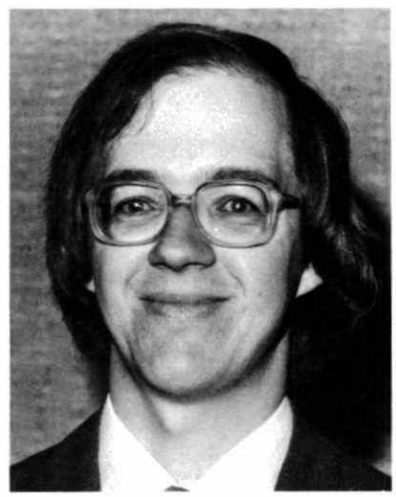
THE BASIS OF THIS PHILOSOPHY IS SIMPLE. WE ALL HAVE A RIGHT TO THE BEST ENVIRONMENT WE CAN HAVE. AND WE ALL HAVE A CORRESPONDING RESPONSIBILITY TO MAKE SURE WE HAVE IT.

NOW, LET'S HAVE SOME QUESTIONS, AND, AFTER THAT, SOME LUNCH.

SESSION II – THE CHALLENGE CONTINUES

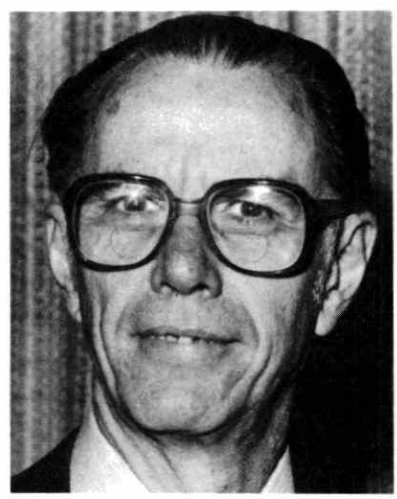
Chairman: D.E. Redgrave
Assistant Deputy Minister,
Environmental Planning Division,
Ontario Ministry of the Environment
Toronto, Ontario

Dr. D.A. Chant
Chairman and President,
Ontario Waste Management
Corporation, Toronto, Ontario



S. Feenstra, Golder Associates,
Mississauga, Ontario

Jim Temple,
Vice-President, Waste Management of
Canada Inc. on behalf of
Ontario Solid Waste
Management Association,
Toronto, Ontario



Dr. John McIrvine, Chairman
Environmental Quality Committee,
Canadian Chemical Producers
Association, Ottawa, Ontario

AN UPDATE ON THE CORPORATION

by
Dr. D.A. Chant
President and Chairman
Ontario Waste Management Corporation
Toronto, Ontario

INTRODUCTION

- First, Mr. Chairman, I want to thank you for the opportunity to address this conference on the subject of the Ontario Waste Management Corporation.

- Many of you in the audience have heard from us or about us on several occassions, I suspect, over the past year; indeed, a year ago at this conference we outlined the purpose, structure and overall approval we were taking to our task, and I don't propose to repeat all of that here this afternoon.

- Rather, I want to summarize briefly for you where we are in our work, touch on a few issues that I think are particularly relevant to this occassion, and then provide an opportunity for your questions.

A) The Facilities Development Project

- First, the planning and search for liquid industrial waste treatment facilities - or the Facilities Development Project as we call it. Where are we in the implementation of this project?

- As you know, our task as a provincial crown agency is to build and manage liquid toxic waste treatment and disposal facilities required in Ontario. But before we can do that, suitable sites for these facilities must be selected, and our detailed proposals presented to an independent Hearing Panel, which will then conduct public hearings.

- Over the past year, three major reports have been issued - one when we rejected the South Cayuga site in November 1981, and two summarizing the completion of the first two phases of our plan - one in September 1982 and the other last January. Estimates on the volume, type and sources of liquid toxic wastes in the Province have been made. Appropriate treatment and

DISPOSAL TECHNOLOGIES HAVE BEEN IDENTIFIED. AN A GEOGRAPHIC REGION - THE GOLDEN HORSESHOE - HAS BEEN SELECTED WHERE THE SEARCH FOR REQUIRED FACILITIES WILL BE CONCENTRATED.

- LAST JANUARY, WHEN WE ANNOUNCED THAT OUR SEARCH WILL CONCENTRATE IN THE GOLDEN HORSESHOE, WHERE 70% OF THE PROVINCE'S LIQUID INDUSTRIAL WASTE IS GENERATED, WE INDICATED THAT SEVERAL IMPORTANT STEPS MUST BE TAKEN BEFORE SPECIFIC SITES COULD BE IDENTIFIED. FIRST, WE MUST CONTINUE TO REFINE AND VERIFY OUR WASTE QUANTITY ESTIMATES, TO ENSURE THAT THESE FACILITIES ARE NOT CONSTRUCTED EITHER TOO LARGE OR TOO SMALL. SECOND, CONSULTATIONS WERE TO TAKE PLACE ON THE PROPOSED SITE SELECTION METHODOLOGY, TO ENSURE WE HAD IDENTIFIED ALL THE APPROPRIATE FACTORS THAT SHOULD BE CONSIDERED. THIRD, MORE INFORMATION MUST BE COLLECTED ON THE ENVIRONMENTAL, LAND USE AND TRANSPORTATION IMPACTS OF EACH OF THE FACILITY COMPONENTS, BEFORE A FURTHER NARROWING OF THE SEARCH WITHIN THE GOLDEN HORSESHOE COULD OCCUR.

- Since January, we have concentrated on these three activities and announced last month several candidate areas within the Golden Horseshoe where the search will not be concentrated. While I don't propose we get into the details of next announcement here, perhaps I could summarize for you some of the general patterns that are now evident as we move ahead with the search process:

  - First, almost all of the candidate areas are potentially suitable for two or three facility components; in other words, the options for a fully-integrated or fully-dispersed system are still open.

  - Second, it is clear that most of the potential choice is in the Niagara Peninsula, with a high proportion of the candidate ares in the Peninsula on Class 1 and Class 2 agricultural land. The amount of specialty agriculture in the candidate areas, however, is quite limited.

- THIRD, THERE IS NOT MUCH INDUSTRIALLY-DESIGNATED AN- PUBLICLY-HELD LAND IN THE CANDIDATE AREAS, ALTHOUGH THERE IS SOME POTENTIAL FOR ESTABLISHING SITES IN THE VICINITY OF INDUSTRIALLY-DESIGNATED AREAS. FOR THESE REASONS WE HAVE ASKED OUR CONSULTANTS TO ENSURE THAT EVERY STEP IS TAKEN TO EXPLORE THE OPPORTUNITY FOR FINDING SUITABLE LOCATIONS ON INDUSTRIALLY-DESIGNATED AND PUBLICLY-HELD LAND. [DAC - OUTLINE HERE ARE USE-OF-AGRICULTURAL LAND ISSUE VERSUS A SECOND-BEST SITE].

- FOURTH, NORTH OF LAKE ONTARIO, THE CANDIDATE AREAS IN THE REGIONS OF PEEL AND HALTON ARE QUITE SMALL, ALTHOUGH MOST ARE POTENTIALLY SUITABLE FOR ALL FACILITY COMPONENTS.

- NOW, WHERE DO WE GO FROM HERE? OVER THE NEXT SEVERAL MONTHS, THESE AREAS WILL BE STUDIED IN DETAIL; WE EXPECT THE ENTIRE PHRASE THREE PROGRAM TO BE CONCLUDED IN THE FALL, WITH THE ANNOUNCEMENT OF SPECIFIC CANDIDATE SITES IN A FINAL PHASE THREE REPORT ISSUED AT THAT TIME. PHASE FOUR WILL THEN

INVOLVE A COMPARISON OF THESE SITES AND THE SELECTION OF A SHORT-LIST, WHICH WILL BE SUBJECTED TO DETAILED ON-THE-LAND STUDIES PRIOR TO THE PREPARATION OF OUR PROPOSAL TO THE HEARING PANEL. IN THE MEANTIME, WE WILL BE CONTINUING WITH OUR PUBLIC CONSULTATION PROGRAM IN THE CANDIDATE AREAS. THIS WILL INCLUDE EXTENSIVE ROUNDS OF MEETINGS, SEMINARS AND DISCUSSIONS WITH RESIDENTS AND ASSOCIATIONS.

B) <u>KEY ISSUES</u>

- NO DOUBT, WE ARE ENTERING THE MOST DIFFICULT AND CONTROVERSIAL STAGE OF OUR PROJECT, AS SPECIFIC AREAS AND SITES ARE IDENTIFIED. WE EXPECTED THAT - ALTHOUGH I STRONGLY BELIEVE THAT SUCH OPPOSITION SHOULD NOT DISCOURAGE US FROM MAINTAINING A STEADY, THOROUGH APPROACH TO THE DEVELOPMENT OF OUR PROPOSAL. ANYTHING LESS WILL RESULT IN FAILURE, - NOT TO MENTION PROTRACTED POLITICAL UPHEAVALS AND COURT BATTLES.

- BUT THERE ARE OTHER ISSUES FACING US AS WELL - ISSUES THAT ARE OFTEN RAISED IN DISCUSSIONS WITH INDUSTRIAL

AND WASTE GENERATOR GROUPS IN PARTICULAR - AND I WOULD LIKE TO SPEND A FEW MINUTES HIGHLIGHTING THEM FOR YOU:

- FIRST, WE ARE OFTEN ASKED HOW BIG OR HOW SMALL DO WE INTEND TO BUILD THESE FACILITIES:

  - OUTLINE CONFLICTING VIEWS - SOME WANT IT BIG - TO 'OOK AFTER ALL WATER - OTHERS WANT IT SMALL TO LOOK AFTER ONLY THOSE WASTES THAT ARE NOT TREATED ELSEWHERE

  - OUTLINE MANY COMPLICATING FUNCTIONS INVOLVED IN DETERMINING SIZE AND THE WASTE VOLUMES WE WILL RECEIVE

    - PRICE
    - INDUSTRIAL PROCEDURE TRENDS
    - RECYCLING TRENDS - UPWARD
    - REGULATIONS - OUTLINE WHAT WE HAVE BEEN TOLD.
    - FINALLY, THE ROLE AND FUTURE PLANS OF EXISTING PRIVATE WASTE TREATMENT OPERATIONS.

- TO APPROACH THIS IMPORTANT QUESTION OF SIZE, WE HAVE TAKEN SEVERAL STEPS:

  - OUTLINE PHASE 2 REPORT'S GUIDELINES

    IN - START-UP
    - CAPABLE OF EXPANSION
    - ABLE TO TREAT ALL <u>TYPES</u> OF WASTE.

  - OUTLINE OUR CURRENT MARKETING EFFORTS - DETAILED DISCUSSIONS ARE NOW OCCURRING WITH INDUSTRIAL GENERATORS, CHEMICAL AND TOXICOLOGY EXPERTS, TO REFINE OUR WASTE ESTIMATES, AND SEEK ADDITIONAL ADVICE ON WHAT IS AND IS NOT TOXIC AND HAZARDOUS -
    [OUTLINE MEANING OF APPENDIX A AND B IN OUR PHASE 1 AND 2 REPORTS.]

- <u>SECOND</u>, THESE ISSUES RAISE THE QUESTION OF OUR RELATIONSHIP TO THE PRIVATE SECTOR; ARE WE BUILDING AN EMPIRE, WE ARE ASKED, INTENT ON DRIVING THE PRIVATE SECTOR OUT OF <u>BUSINESS</u>. THE BUSINESS OF INDUSTRIAL WASTE MANAGEMENT?

- I WANT TO BE QUITE CLEAR ON THIS SUBJECT. OBVIOUSLY, IT MUST NOT AND SHOULD BE OUR INTENTION TO DUPLICATE, UNNECESSARILY, WHAT IS NOW BEING PROPERLY TREATED. AND TO SIGNIFICANT PROPORTION OF THESE WASTES ARE BEING ADEQUATELY TREATED BY THE LARGER COMPANIES IN THE PROVINCE.

  BUT WHAT IS YOUR DEFINITION OF ADEQUATE TREATMENT? AND HOW CAN OWMC BE COST-EFFICIENT IN ITS OPERATIONS IF IT DOES NOT HAVE A REALISTIC PRICING AND MARKETING POLICY? AND HOW IT STIMULATES AND ENCOURAGES ADEQUATE PRIVATE WASTE TREATMENT <u>AND</u> RECYCLING?

  - I BELIEVE WE CAN ACT AS A STIMULANT IN THE INDUSTRY - FOR THE RECYCLING INDUSTRY, FOR THE TRANSPORTATION INDUSTRY, AND THE WASTE TREATMENT INDUSTRY. BUT THIS WILL ONLY OCCUR IF WE HAVE A WELL-THOUGHT OUT MARKETING POLICY, BASED ON INPUT FROM A WIDE RANGE OF SOURCES.

- In meetings we have had with literally hundreds of groups and organizations throughout the province in recent months, we have received sometimes conflicting advice on all of the these issues:

  - From industry's perspective, we have been told that a treatment and disposal facility is badly needed. Small and medium-size companies in particular do not have the capital or resources to take care of their own wastes. "Get on with the job," we are often told, "and don't try to run a popularity contest. Face up to the inevitable, and find a site quickly."

  - From many environmental groups, we are told that too much emphasis is being placed on finding sites, and not enough on finding ways to reduce and recycle wastes.

  - From the agricultural community, we are told that good food-producing land should

NOT BE TAKEN OUT OF PRODUCTION, AND SACRIFICED TO A WASTE TREATMENT FACILITY, AND OTHER INDUSTRIES MIGHT BE ATTRACTED TO THE AREA, WHICH THEY FEEL IS UNDESIRABLE.

- FROM THE RURAL COMMUNITIES, WE ARE TOLD IT WOULD BE UNWISE AND UNACCEPTABLE TO LOCATE ALL THE FACILITIES IN ONE PLACE, PARTICULARLY RURAL SETTINGS.

- FROM OTHERS - PARTICULARLY IN URBAN SETTINGS - WE ARE TOLD THAT THE FACILITIES <u>SHOULD</u> ALL BE IN ONE PLACE, AND IN A REMOTE LOCATION FAR REMOVED FROM URBAN CIVILIZATION.

- FROM INDUSTRY, WE ARE WARNED - JUSTIFIABLY IN MY OPINION NOT TO OVER-SIZE OUR FACILITIES, AND TO MAKE SURE OUR PROCESSING FACILITY REFLECTS TRUE COSTS OF TREATING AND DISPOSING OF WASTES.

- DESPITE THESE DEFERRING AND SOMETIMES CONFLICTING VIEWS, WE HAVE RECEIVED AT LEAST ONE CONSISTENT MESSAGE. DO IT RIGHT. THERE WILL BE NO GENERAL CHANCE FOR AN "OWMC" IF WE FAIL THIS TIME. BUT WE MUST ACT. AND THAT WE SHALL DO AS THE MONTHS AHEAD WILL NO DOUBT ILLUSTRATE FOR US ALL!

- MR. CHAIRMAN, THAT CONCLUDES MY OVERVIEW OF THE PRESENT WORK OF OWMC. I HOPE I HAVE BEEN ABLE TO DO JUSTICE TO ALOT OF INFORMATION - AND THE COMPLEX ISSUES THAT FACE US. I'LL BE HAPPY TO ANSWER ANY QUESTIONS YOU MAY HAVE.

CO-DISPOSAL OF INDUSTRIAL WASTES WITH MUNICIPAL WASTES IN LANDFILLS:

A PROSPECTUS*

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INTRODUCTION

The co-disposal of industrial wastes with municipal wastes, in the context of this paper, refers to a controlled procedure where one or more types of hazardous industrial wastes are disposed with municipal wastes in a municipal landfill. Hazardous industrial wastes in this case are defined as industrial wastes recognized as containing hazardous contaminants in concentrations or total amounts which could be considered to represent a potential threat to the environment and/or to human health if disposed of in an uncontrolled manner.

During the 1980's, it is likely that a small number of 'secure' disposal sites will be developed in Canada specifically for the disposal of hazardous industrial wastes. It is anticipated that such facilities will be selected, designed, engineered, and operated according to very rigorous and exacting specifications to provide a very high degree of containment of leachate within the landfill, and will thus prevent any significant release of hazardous contaminants from the landfill into the hydrogeologic environment (see Figure 1). However, there is likely to be only a small number of such 'secure' facilities compared to the very large amounts of industrial waste materials which may be regarded as containing potentially hazardous contaminants.

It would therefore be highly advantageous to reduce the amount of waste directed to these 'secure' disposal facilities by selectively co-disposing certain types of hazardous industrial wastes into conventional municipal landfills provided that it can be demonstrated that this co-disposal does not result in any detrimental environment impacts.

In contrast to a 'secure' disposal site, a municipal landfill is not necessarily designed to provide a high degree of leachate containment. Landfills situated on relatively impermeable geologic materials (clay) are not generally characterized by a significant flux of leachate out of the landfill, and consequently do not generally have a significant impact on

the groundwater. However, the infiltration of precipitation into the landfill may still result in the production of leachate within the landfill and may result in leachate springs emerging from the sides of the landfill (see Figure 2). Landfills situated on relatively permeable geologic materials (sand) are generally characterized by the infiltration of precipitation into the landfill and the production of leachate within the landfill, with a resulting flux of leachate out of the landfill into the groundwater system (see Figure 3). This type of landfill relies on physical and chemical processes within the landfill and in the hydrogeologic environment to attenuate the migration of contaminants away from the landfill. Therefore, the general assessment of the environmental impact of the co-disposal of industrial wastes in these 'non-secure' landfill settings will require an adequate understanding of the physical and chemical processes that control the chemical composition of leachate, and of the chemical attenuation processes which occur within the landfill and in the groundwater.

This paper is based on a review of the current state of knowledge related to the co-disposal of hazardous industrial wastes with municipal wastes into landfills. This review was conducted by Golder Associates in co-operation with M.M. Dillon Limited, under contract to the Waste Management Branch of Environment Ontario. The objective of the review was to identify any significant uncertainties in the current state of knowledge related to landfills and co-disposal which could inhibit the adequate assessment of the environmental impact of co-disposal. The review considered the current state of knowledge in six principal areas:

1. Classification of industrial wastes
2. Leachate production
3. Contaminant migration in groundwater
4. Chemical behaviour of contaminants in groundwater
5. Modeling of contaminant migration in groundwater
6. Engineered controls

Information was gathered from an extensive review of the relevant technical and scientific literature. The results of this review are described below and the key areas of uncertainty identified.

RESULTS OF THE REVIEW

Although considerable information exists on various aspects of both municipal and industrial waste disposal and is relevant to co-disposal, there are several areas in which there is a significant degree of uncertainty. These key areas of uncertainty include:

1. The assessment of the potential interactions between different types of hazardous industrial wastes and municipal wastes or other hazardous wastes;

2. The chemical behaviour of hazardous organic contaminants in leachate and groundwater;

3. The reliability of computer models in the prediction of contaminant migration of groundwater;

4. The long-term performance and integrity of the engineered controls.

1. Interactions Between Wastes

Potential chemical interactions which can result from the co-disposal of different types of industrial wastes with municipal wastes can cause immediate chemical reactions such as ignition, explosions or the generation of toxic fumes. The occurrence of such reactions during landfilling operations poses a significant threat to health and safety and must be avoided. Chemical interactions resulting from co-disposal can also cause a modification of the chemical composition of the leachate. Chemical interactions between the wastes can result in either the

production or degradation of hazardous contaminants in the wastes, or similarly, result in either enhanced or reduced mobility of hazardous contaminants in the leachate. The following are some examples of chemical interactions between wastes which can be important to the production of leachate in co-disposal landfills.

(i) Interactions which can influence the Production of Hazardous Contaminants.

- the interaction between acidic wastes with wastes containing sulfide or cyanide compounds can result in the production of highly toxic hydrogen sulfide and hydrogen cyanide gas (Hatayama et al., 1980).

(ii) Interactions which can influence the Degradation of Hazardous Contaminants.

- organic contaminants such as lindane, toluene, benzene and toxaphene are biodegradable but high concentrations of these, or other contaminants may inhibit this biodegradation (Koyabashi and Rittman, 1982).

- organic contaminants such as DDT, 2,4,5-T, aldrin and heptachlor cannot be directly degraded, but can be degraded indirectly by micro-organisms which are dependent on other substances for nutrients and energy. This process is referred to as co-metabolism (Alexander, 1981).

- chromium (VI), the toxic form of chromium, is reduced to non-toxic chromium (III) by the vegetable organic matter in municipal wastes (Summer, 1978)

(iii) Interactions which can Enhance the Mobility of Contaminants in Leachate

- the interaction between cyanide wastes and wastes containing heavy metals can result in the enhanced mobility of the heavy metals due to the formation of soluble metal-cyanide complexes.

- the interaction between acidic wastes and wastes containing heavy metals can result in the enhanced mobility of the heavy metals.

(iv) Interactions which can Reduce the Mobility of Contaminants in Leachate

- many toxic organic contaminants such as dieldrin, chlordane and PCB are highly adsorbed on vegetable organic matter (Koyabashi and Rittmann, 1982; Griffin and Chou, 1980). Many heavy metal contaminants are also highly adsorbed on organic matter.

Another important consideration in the assessment of leachate production in co-disposal landfills is that the abundant organic matter in the municipal wastes will decompose and progressively produce anaerobic conditions within the landfill. The occurrence of anaerobic (reducing) conditions versus aerobic (oxidizing) conditions within the landfill can have an important effect on the chemical reactions which can occur in the landfill. The co-disposal of wastes containing organic contaminants such as cyanide, benzene, endrin and phenols, which are only biodegradable under aerobic conditions, may not be considered appropriate in an anaerobic landfill environment. Conversely, the co-disposal of wastes containing organic contaminants such as ethylbenzene, napthalene, aldrin, lindane and toxaphene, which are only biodegradable under anaerobic conditions, may be appropriate in an anaerobic landfill environment.

The waste classification system developed by Hatayama et al. (1980) is particularly applicable to co-disposal because it relates various waste producing industries and particular waste-streams to the general chemical composition of the wastes, and provides a preliminary assessment of the compatibility of binary combinations of different types of waste. Such a classification system is generally suitable for the assessment of waste compatibility based on immediate chemical reactions such as ignition and explosions. However, in terms of the chemical composition of leachate resulting from co-disposal, the number of potentially important chemical interactions between the wastes borders or the infinite because of the very large number of waste types and chemical constituents (particularly organic compounds) in the wastes.

From the preceeding discussion, it is evident that the selective co-disposal of specific types of hazardous industrial wastes with municipal wastes, or other types of industrial wastes, could potentially improve the chemical composition of leachate produced from co-disposal landfills. In addition, it is evident that the co-disposal of some types of hazardous industrial wastes with municipal wastes, or other types of industrial wastes, could be potentially undesirable in terms of the leachate produced. At the present time, however, there is insufficient data on the chemical behaviour of contaminants, particularly hazardous organic contaminants, in chemically complex landfill environments to allow the detailed evaluation of the chemical composition of leachate from co-disposal landfills.

2. Chemical Behaviour of Hazardous Contaminants

The chemical behaviour of hazardous contaminants in landfill leachate and in groundwater has an important influence on the chemical composition of leachate produced in co-disposal landfills and the potential migration of contaminants away from landfills in groundwater. The mobility of hazardous inorganic contaminants, particularly heavy metals, will be principally controlled by:

- complexation by inorganic and organic ligands
- dissolution/precipitation reactions
- adsorption on wastes and soil materials.

The mobility of hazardous organic contaminants will be principally controlled by:

- solubility in water
- adsorption on wastes and soil materials
- chemical and biological degradation reactions
- volatilization

In the course of this review, the general chemical behaviour of the contaminants on the USEPA list of 129 Priority Pollutants was compiled.

The geochemical behaviour of most hazardous inorganic contaminants in water has been relatively well documented in the scientific literature and it is apparent that inorganic contaminants such as heavy metals are not generally mobile under most geochemical conditions. Heavy metals and transition metals generally have solubility constraints and are readily adsorbed by geological materials at neutral and high pH, although they can be mobile at low pH.

At most landfill sites in humid regions of North America, high mobility of toxic heavy metals, transition metals and metalloids does not appear to be a problem. Cherry (1982) indicated that concentrations of these contaminants at three landfill sites in Ontario, were consistently below drinking water standards (see Figure 4). Similar results were found by Kimmel and Braids (1980) for landfills on Long Island. Although the mobility of inorganic contaminants may be enhanced by complexing with both inorganic and organic ligands, in most cases, it does not appear that the formation of complexes is generally important in landfill environments.

In other settings such as industrial waste lagoons and sewage oxidation ponds, hazardous inorganic contaminants have migrated large distances away from the disposal site. Perlmutter and Leiber (1970), in a study conducted in Nassau County, Long Island, New York, documented the movement of hexavalent chromium and cadmium more than 1300 m from an industrial waste lagoon. Wolfberg et al. (1980) indicated that contaminant plumes of several heavy and transition metals from a sewage oxidation pond extended more than 100 m in a sand aquifer in Isarel. Organic complexing of the heavy metals was suggested as a mechanism enhancing metal mobility in these cases.

In contrast with inorganic contaminants, there is general paucity of documented information on the behaviour of organic contaminants in hydrogeologic environments and few generalizations can be made. Field studies in a variety of hydrogeologic settings indicate that extensive groundwater contamination problems have developed as a consequence of highly mobile organic contaminants such as methylene chloride, trichloroethane, carbon tetrachloride and trichloroethylene (Duffy et al., 1980; Gass, 1980; Roux and Althoff, 1980; Weimar, 1980). Reinhard and Barker (1982) found some of these organic contaminants such as trichloroethylene in plumes emanating from two municipal landfills in Ontario which accepted limited quantities of industrial wastes. Many of these mobile organic contaminants have high solubilities in water and can occur in groundwater in concentrations that are many orders of magnitude above drinking water standards. The dilution of contaminants in groundwater by dispersion would not provide sufficient attenuation of such contaminants, consequently the importance of chemical and biochemical attenuation processes is magnified.

Other organic contaminants such as napthalene, chlordane and PCB are not generally mobile in groundwater due to attenuation processes such as adsorption and biodegradation. However, although the attenuation mechanisms that act to decrease the concentration of organic contaminants in groundwater have been identified, the rates at which and the degrees

to which they occur are not clearly known (Cherry et al., 1982). Theoretical predictions of the adsorption coefficients of organic contaminants by sedimentary organic material (Karickhoff, 1979; Kenaga, 1980; and Schwarzenbach and Westall, 1981) have generally agreed within a factor of 10 with those determined experimentally; however, some unexplained discrepancies exist. Davidson et al., (1980) indicated that theoretical predictions of adsorption of pesticides did not adequately describe adsorption observed from high-concentration solutions which could feasibly exist at waste disposal sites. Koyabashi and Rittmann (1982) have summarized previously reported cases of biodegradation of many organic contaminants and the conditions under which they occurred. At high concentrations, and in the presence of other contaminants, biodegradation may be inhibited and thus, there is some degree of uncertainty when applying the results of biodegradation studies for predictive purposes at waste disposal sites.

3. Modeling of Contaminant Migration

The ability to solve the mathematical equations of groundwater flow and contaminant migration in groundwater has increased significantly in the last few years; however, there remains some uncertainty as to the reliability of computer models for the prediction of contaminant migration. Analytical models are relatively easy and inexpensive to use, and can provide a general indication of how contaminants behave in simple hydrogeologic settings. They are limited, however, in their application because of the simplifying assumptions necessary for their use. Contaminant migration in more variable and complex porous hydrogeologic media can be simulated by numerical techniques, however, such models have not yet proven to be entirely reliable in simulating contaminant migration from landfills. These methods are currently susceptible to numerical dispersion, or an erroneous degree of dispersion of contaminants predicted by the computer models due to computational approximations in the solution process, rather than due to the actual hydrogeologic conditions.

Although advances in mathematical approaches to the contaminant migration problem are necessary, they are not the limiting factor in the future applicability of predictive models for contaminant transport in porous geologic media. It is imperative that a more complete theoretical understanding of dispersion be developed to warrant the continued wide-scale use of advection-dispersion models for the simulation of contaminant migration. Similarly, processes such as the adsorption and biodegradation of hazardous organic contaminants must be more clearly understood before they can be described mathematically and simulated in predictive models. It is also essential that techniques of collecting accurate and sufficient data in the field be improved, to describe adequately the hydrogeologic setting so that appropriate values for parameters such as dispersivity and retardation coefficients can be used as input to the computer models. Although the use of computer models is not yet sufficiently reliable for quantitative predictions of contaminant migration in groundwater, the use of computer models can provide considerable insight and qualitative understanding of contaminant migration and the processes which control it.

Contaminant migration in complex, fractured geologic media (both rock and weathered clays) has not been satisfactorily modeled, and it is unlikely that it can be attained with the current understanding of contaminant migration in fractured media and the modelling techniques presently in use.

4. Engineered Controls

The production of leachate within, and the migration of leachate from, landfills can be controlled by various engineering practices. The volume of leachate produced can be minimized by restricting infiltration of precipitation into the landfills. Low permeability cover layers have been considered to minimize the infiltration of precipitation into

landfills following close-out and would be of benefit for landfills situated on both permeable or impermeable geologic materials. For landfills situated on permeable materials, a low permeability cover would reduce the amount of infiltration and consequently reduce the flux of leachate out of the landfill into the hydrogeologic environment. For landfills situated on impermeable geologic materials, a low permeability cover would reduce the occurrence of leachate springs. However, the long-term performance and integrity of landfill covers has not been throughly documented.

The containment of leachate within landfills can be enhanced by the use of natural clay or synthetic landfill liners. Clay liners have been used extensively but there is recent evidence that interactions between clay minerals and certain organic fluids can result in significant increases in the hydraulic conductivity of clay liners (Anderson et al., 1982; Green et al., 1979, 1981). Synthetic liner materials have also been used to improve containment but these liners can be subject to adverse reactions in the presence of certain hazardous wastes and the longevity of these materials in landfill settings is not known (Haxo, 1981).

CONCLUSIONS

Based on the results of the review of the existing state of knowledge, the prognosis for the safe disposal of wastes containing hazardous inorganic contaminants in municipal landfills would appear to be more favourable than for the safe co-disposal of wastes containing hazardous organic contaminants. This prognosis is based primarily on the relative level of understanding of the geochemical behaviour of hazardous organic and inorganic contaminants.

The review of existing data pertaining to hazardous organic contaminants in groundwater indicates that:

- the behaviour of hazardous organic contaminants in landfill and hydrogeologic environments is not well understood;

- the solubilities of many of the hazardous organic contaminants in water are very high and can occur in concentrations many orders of magnitude higher than drinking water standards;

- there is evidence that many hazardous organic contaminants are mobile in a variety of hydrogeological settings. Attenuation mechanisms such as biodegradation and adsorption can not be quantified with sufficient confidence to predict the possible future extent of contaminant migration;

- there is evidence to suggest that some organic chemicals can cause degradation of either clay or synthetic membrane landfill liners.

- there is a very large number of potentially hazardous organic compounds that have been or are presently being produced by industry and many of these could be encountered in various industrial wastestreams.

With this degree of uncertainty and the lack of predictive capability with respect to the behaviour of hazardous organic contaminants in hydrogeologic environments, the co-disposal of hazardous organic wastes and municipal wastes in landfill settings would not appear to be promising at this time. This general lack of understanding of the behaviour of hazardous organic contaminants in groundwater, coupled with the high costs and procedural difficulties associated with groundwater monitoring and chemical analysis programs for hazardous organic contaminants, indicate that it is unlikely that many of the uncertainties pertaining to the co-disposal of hazardous organic wastes with municipal wastes could be resolved without major research efforts which would be complex, time consuming and costly.

Better possibilites, however, exist for the co-disposal of hazardous in inorganic wastes with municipal wastes in landfills. Based on field and laboratory experience and the present understanding of the geochemical behaviour of inorganic contaminants in groundwater, it appears that most heavy metals have generally limited mobilities in near-neutral pH, hydrogeologic environments. Research efforts with regard to the co-disposal of hazardous inorganic wastes with municipal wastes in landfills have the potential of yielding more definitive results because of the present level of understanding of the behaviour of hazardous inorganic contaminants in hydrogeologic systems.

ACKNOWLEDGEMENTS

This paper was based on work funded by the Waste Management Branch of the Environmental Protection Service of Environment Canada and the Waste Management Branch of the Environment Ontario. The authors wish to thank Mr. Ken Childs of Environment Canada, and Mr. Joe Petoia and Mr. Wes Williamson of the Ontario Ministry of the Environment for their encouragement in undertaking this work.

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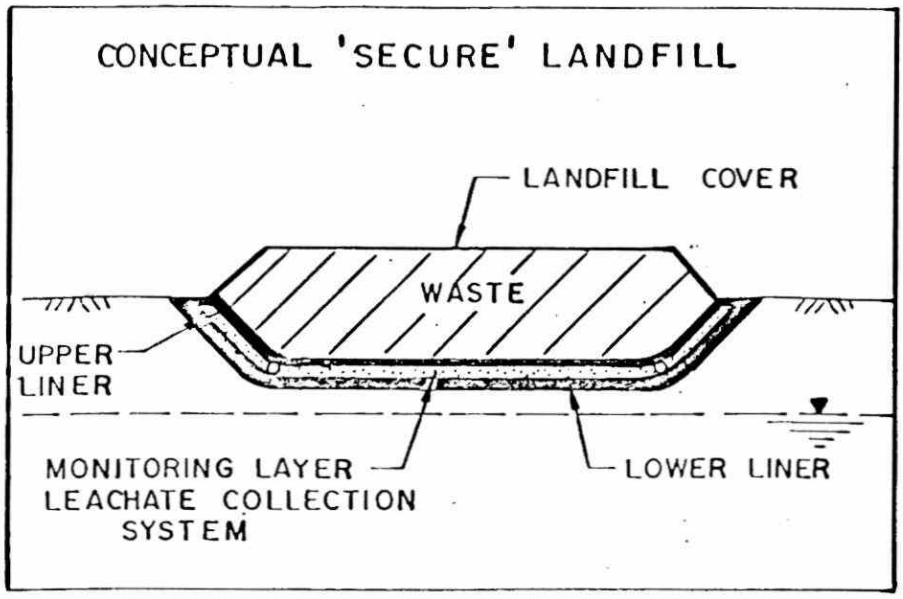


FIGURE 1: CONCEPTUAL 'SECURE' LANDFILL

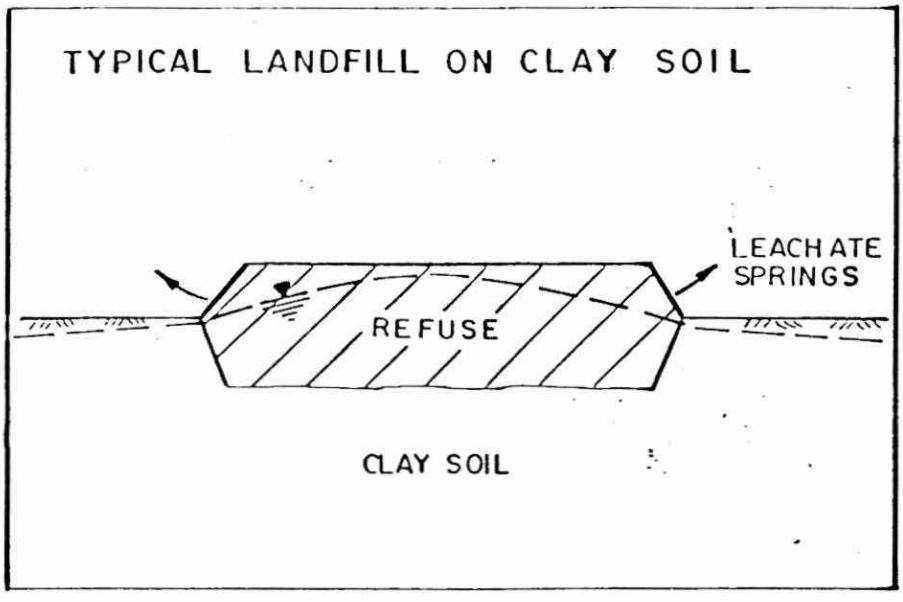


FIGURE 2: TYPICAL MUNICIPAL LANDFILL SITUATED ON CLAY SOIL

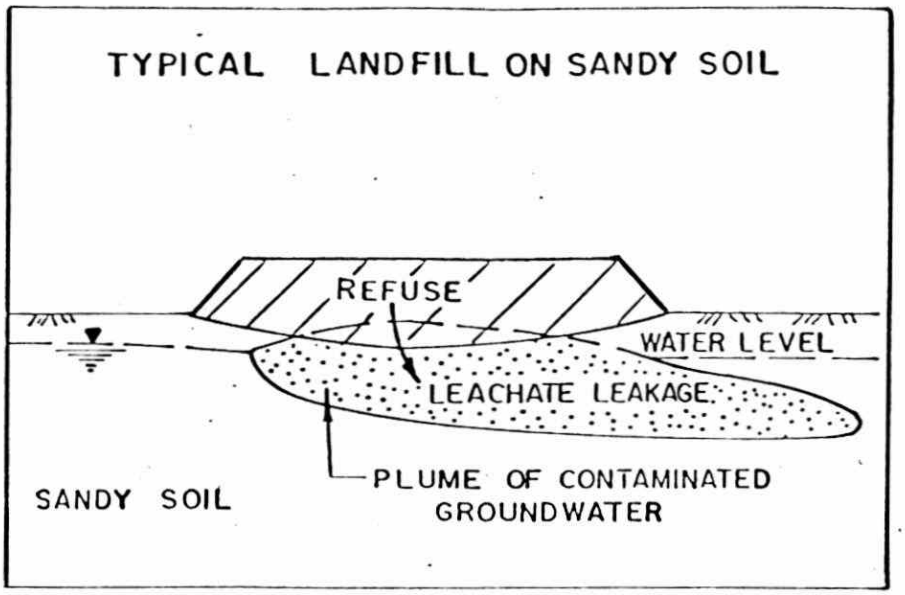


FIGURE 3: TYPICAL MUNICIPAL LANDFILL SITUATED ON SANDY SOIL

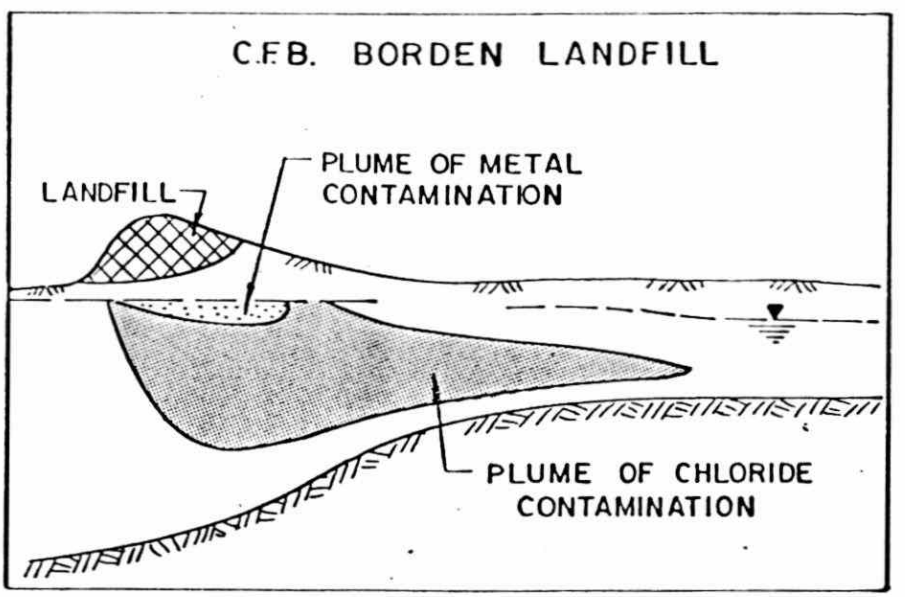


FIGURE 4: SCHEMATIC OF GROUNDWATER CONTAMINATION AT THE C.F.B. BORDEN LANDFILL (CHERRY, 1982)

PERSPECTIVES FROM THE WASTE MANAGEMENT INDUSTRY

by

Jim Temple, Vice-President, Waste Management of Canada Inc., on behalf of the Ontario Solid Waste Management Association, Toronto, Ontario.

Mr. Temple spoke from notes and did not have a formal text. No formal paper is available for inclusion in the Proceedins.

HAZARDOUS WASTE MANAGEMENT FOR ONTARIO
INDUSTRY PERCEPTIONS OF THE BLUEPRINT

by

DR. JOHN D. MCIRVINE
MANAGER ENVIRONMENTAL PROTECTION
C-I-L INC.

CHAIRMAN CANADIAN CHEMICAL PRODUCERS ASSOCIATION
ENVIRONMENTAL QUALITY COMMITTEE

It is my priviledge to appear this afternoon to present the viewpoint of the chemical industry to several parts of the new Blueprint for Waste Management.

The Canadian Chemical Producers Association is the trade association for the chemical manufacturing industry in Canada. The Canadian chemical industry is managing gross assets of about $13.3 billion and an annual gross value of shipments of almost $12.7 billion, which is about 6.8% of Canada's output of manufactured goods. The industry employs 88,000 people. The CCPA's 63 members produce over 80% of the $9 billion worth of industrial chemicals and resins manufactured in Canada each year.

Each year our Technical Management Committee evaluates the priority of the various active issues with which we must deal. For several years, the topic of hazardous waste management has been first or second on this list. We have therefore been dealing extensively with the topic, and are pleased to be invited to present our perspective on this comprehensive initiative by the Ministry for dealing with the diverse activities involved in hazardous waste management.

My presentation this afternoon will begin with a brief bit of background. CCPA has developed a position paper expressing its concerns for sound management of hazardous wastes, and I will outline the key points contained in it.

Next, I will outline our reactions and perspective to those parts of the Blueprint which have been made available for review in draft form. This will include comments on the overall concepts expressed in Mr. Norton's address to the Toronto Board of Trade last November.

CCPA POSITION ON MANAGEMENT OF HAZARDOUS WASTES

Copies of the CCPA policy paper on Hazardous Waste Handling and Disposal are available for anyone who has not yet seen the printed document. This paper grew out of a long-standing concern for responsible waste disposal. These views are summarized in nine key points, which are presented in detail in the printed paper. These are:

disposal of hazardous wastes is a problem which cannot be solved by unilateral action. It must involve joint effort and cooperation between federal, provincial and municipal governments and industry

there is a need for a clear definition of terms based on supportable scientific facts

regulations should be based on demonstrated need, and compliance with them should be achieved by the most appropriate of the alternative cost-effective means available

public acceptance of waste disposal sites should be accelerated by education and information programs covering a range of topics about disposal technologies, protection of human health and the environment, and hazards. Industry believes that it must be involved in this process

the federal government role should be concentrated on research, information transfer, education, and the provision of possible interim financial incentive programs to stimulate the establishment of necessary disposal facilities and enhance waste reduction and recycling initiatives

provincial governments have the main jusisdictional responsibility for waste disposal, and their roles should include the enaction of control legislation and regulations, and equitable enforcement

the sound management of waste collection and secure disposal operations can be effectively and efficiently carried out by industry once the regulatory requirements are clearly established

industry does not have the power to establish criteria for the selection or designation of disposal sites. This is properly a task for government, and requires the prompt level of attention which the ministry has accorded to it.

proprietary information with regard to waste volumes and content should be accorded confidential status where this is appropriate

Our position is clearly that there must be in existence a workable system for dealing effectively with hazardous wastes which achieves adequate protection of the environment without inhibiting economic progress.

THE BLUEPRINT

Overview

This morning we have heard the Ministry presentation on the Blueprint for Waste Management. This has developed from the concepts mentioned by the Honorable Keith Norton in an address to the Toronto Board of Trade last November.

This speech - and I refer you to the published text - is a concise summary which successfully puts the topic into perspective. It is worth therefore taking a few minutes to identify the important thoughts which it contained.

The first of these was the fundamental point that waste is generated inevitably by most of societies activities. Industrial waste is only one part of the whole problem. And hazardous wastes are only one part of that.

Mr. Norton's next points were that this is a mutual problem. Furthermore, it is not a new problem. Wastes have always been generated as a natural side-effect of human activities. Ontario has had strong legislation controlling the release of such wastes into the environment for many years, and its reputation is an envious one.

The next point was one of perspective. Wastes can become a resource, and alternatives to disposal should be considered.

Concluding that there is still more to be done, Mr Norton then outlined objectives for the future, and indicated that development of the Blueprint would be a twelve-month process. The Blueprint is of course the substance of that overall management plan.

The key objectives warrant identification. These are:

active public participation

consistent planning, coordinated with land-use planning

minimal further use of landfill disposal options

perpetual care of all waste sites

firm but flexible control, with accountability

the use of up-to-date technical knowledge

secure disposal

Similarly, the key action items identified were:

improved classification systems for waste materials

the monitoring and control of hazardous wastes throughout from origin to final disposal

clarification of responsibilities

the integration of long term planning with land-use planning

the use of an effective hearing process in environmental assessment of proposals for new or expanded site facilities

the review of monitoring, inspection and approvals to control waste handling, treatment and disposal

the application of best existing technical information to waste management

From the industry viewpoint, we applaud these objectives, and the ambitious action plan proposed. Many of the points also appear in the CCPA policy paper. We thoroughly support the concepts of a comprehensive management process, with sound technical foundations. We share the objective of protection of the environment, and recognize that this must be done in a society which values its quality of life, and wishes to grow and prosper.

To focus for a moment more closely on the element of land-use planning, we in industry perceive that major advances could be made through modest changes in concepts. Precedent exists in obliging local governments to service their own needs. We suggest that an extension of this concept could be valuable. Obliging towns or municipalities which benefit from the presence of waste producing industries to provide for facilities, and permit appropriate treatment and disposal of at least those wastes generated in their jurisdiction, would overcome several of the obstacles now thrown up to new sites, and introduce a needed element of fairness and social justice into the controversy.

Furthermore, we support strongly the concepts of public participation in the process.

Blueprint Elements

Through CCPA and other trade contacts, we have had the opportunity to review and reflect on several, but not all, of the component parts of the Blueprint program. We understand that the complete program will embrace some 22 component parts. Some elements are already being introduced, and will need little change. Some do not apply to industry. Those which do, which have been reviewed, and which will be the subject of further comments, are as follows:

The Interim Guideline for the Interpretation of the Hazardous Waste Definition (Regulation 309) March 1983

The Proposed amended Regulation 313 (formerly 926/76): Transfer of Liquid Industrial Waste, Site-Specific Waste and Hazardous Waste

Proposed Regulation ( ): Registration for Generators of Hazardous Waste, Site-Specific Waste and Liquid Industrial Waste

Discussion Paper: Definition for Recycle Material and Recycle Fuel

My remaining comments will be aligned with each of these.

Definition: Regulation 309

The chemical industry strongly endorses the concept of basing waste classification and definition systems on scientifically defensible criteria. We see little room for guesswork or subjective perceptions here, since the costs of dealing with non-issues and 'political pollutants' can be substantial. We are pleased therefore to see the Blueprint using an integral schedule of criteria.

The draft Regulation 309 includes a series of schedules as well, and we reserve judgement about this concept. The use of schedules is acceptable as a convenience to allow users to avoid repetitious testing, or as an interim measure if detailed testing of waste characteristics have not been completed. They should however be compatible with the criteria.

We note that the major elements of the schedules follow generally the system under development by the EPA in the U.S. This is valuable, since there is a strong case for consistency throughout North America. There is movement of wastes across borders, and identification and control can be improved by having consistent classification systems. We are also complimentary in pointing out that Ontario integrates the criteria with the use of schedules, while the EPA system does not. We see the Ontario system as achieving advantages by doing this.

A system must exist for ensuring compatability. This means having a mechanism for resolving any disputes which may arise concerning the appropriate listing of a particular material on the schedules. To contribute constructively to this, we strongly suggest that the proposed Listing Committee include representation from those who generate and understand best the waste under study.

A key part of the Blueprint is its introduction of the somewhat unique concept of site-specific waste disposal. This permits the use of expert judgement on the risks. There are many materials which need appropriate care beyond that given to domestic wastes, but which do not need exotic and expensive provisions to secure them. We support the diversification of the system. This has potential to allow the use of a hierarchy of considerations to govern the disposal of wastes in the province. We see it as able to achieve desireable flexibility in use of disposal options.

The classification system decision tree included in draft Regulation 309 uses a leach test as a key in its decision making. We feel that some of the technical details of this test require further study, and suggest that consultation between all interested parties, including industry, be used to achieve this, soon. In passing, we note that the U.S. EPA leachate test, upon which this part of Regulation 309 is based, is currently under review.

The leachate evaluation is ultimately compared to a multiple of the Ontario Drinking Water Quality (DWQ) standards. We understand that the intent is to make Regulation 309 compatible with the official DWQ criteria, as published for example in the Water Management Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment, November 1978 (the blue book). As printed, the figures in the draft Regulation 309 do not agree with the DWQ figures in the blue book.

We accept the use of a multiplier on the DWQ criteria as one technique for dealing with a complex connection between concerns about the components in the waste and their release to the surroundings. However we suggest that in practice drinking water will not always be directly relevant to leachate from waste disposal. Other attenuation such as that provided by distance and degradation will usually take place. A single multiplier cannot be uniformly applied. We therefore suggest provision be made for varying the numerical value of the multiplier, as appropriate. Ideally it would be desired to use this as a tool to allow the control of the disposal process to match the risks involved.

Site testing for hydrogeological characteristics is required under the draft Regulation 309. We endorse this, particularly for existing sites which have the potential capability for taking some industrial wastes. A transition period will be needed to cover the time during which the hydrogeological studies are carried out and interpreted. We urge that one eventual result be a published schedule of the results for all sites, preferably in a form which will link these to the leachate sensitivity criteria incorporated in the decision tree of draft Regulation 309. This will ultimately reduce or eliminate retesting and wasteful duplication of effort.

And if I may make a final conceptual comment, it is that the definition and classification system should avoid encouraging overclassification, or application of the 'hazardous' label to avoid testing, to avoid decision making, or to avoid criticism. The judgements for classification should be based on scientifically defensible assessment of the appropriate criteria.

Generator Regulations

The proposed regulation for generators, as yet unnumbered, introduces a number of new obligations. Key among these is the requirement to obtain a generator number. Speaking mainly as a representative of large industry, this poses no serious problem for our large plants, but if I may speak also for small industry and for other, more widely dispersed and diversified operations, the system will be workable only if it is kept simple. Responses to complex information questionnaires will not be obtained easily from small operations.

We suggest that failure to keep the impositions on small operations to a minimum will result in either failure of the system or in a shifting of the complex paperwork burden to the licenced haulers or to the suppliers of raw materials. Neither of these is desireable, or meets the more fundamental objective of getting the waste generator to analyze and know the magnitude and nature of his waste 'problem'.

We support the flexibility contained in the emergency exemption provisions, for application in the event of an accident or other mishap. These could be enhanced by making the emergency procedures compatible, and preferably identical, to those of existing emergency response systems. For example, the emergency information required could be provided by having the Emergency Response (ER) forms, formerly known as HIER cards, extended to waste materials.

On the other hand, we feel that the flexibility for handling loads refused at the destination needs to be greater. Allowance should be made for location of alternate destinations, and the mandatory return of the vehicle and its load of potentially hazardous waste to the source eliminated. Needless trucking is costly, and unnecessarily increases the risk to which the public will be exposed.

The obligations on a generator handling site-specific wastes on his own site are no less onerous than for disposal off-site, and are no less restrictive than for hazardous wastes. We suggest a less complex system can achieve equal protection of society and the environment, since on-site disposal is under the control of the generator, no transportation is involved. Site-specific wastes are after all, by definition, not hazardous.

In summary, we accept the value of identifying the generator and qualifying his wastes before they connect into the integrated waste management system. However we suggest that the accompanying paperwork requirements are overly complex, and suggest that a more streamlined system with clearly stated objectives and an increased delegation of responsibility for judgement of special cases at the local level be instituted.

Waybill

Proposed amendments Regulation 313 (formerly 926/76) extend the use of the waybill system now in place for hauled liquid industrial wastes, and modify the system in detail.

New definitions are needed, for inert liquid waste and for recycle material, both of which will be excluded from the category of liquid industrial waste and hence not subject to control by waybills under the proposals.

We are delighted that the new form as described will incorporate six copies, permitting closing of the communications loop by confirming to the generator that the waste has reached the intended destination successfully.

CCPA has for some time been negotiating vigorously to achieve consistency between the waybill requirements of various jurisdictions. For business, compatability is essential. At the very least, the forms used must be acceptable under a reciprocity agreement to the Ministries of other provinces and to EPA in the U.S. Ideally, one country-wide form is desireable. We are disappointed that Ontario, which has been a leader in this area, has not chosen to adopt the National Uniform Hazardous Waste Manifest, which they participated in designing.

In the details of the proposed amendments Regulation 313, we suggest that the small quantity exemption limit, at 25 litres per month, is extremely low, and should be reconsidered.

The system described for keeping tight control of all printed copies of the waybill, by making carriers accountable for them, is seen as inhibiting, and a major obstacle to adoption of the uniform manifest given that much of the value of this control is achieved only after the form is used for a specific shipment. Control of forms can assist control of the system, only after a shipment is initiated.

For protection of the generator, a mechanism is required to allow the generator to establish the current status of the carrier's certificate of approval or provisional certificate, so that he does not let his consignment go to unlicensed haulers.

In summary, the changes are perceived as partly evolutionary, and partly as moving to make the integrated system more rigid. Increased management control of the system is accepted as desireable, but flexibility is needed and increased paperwork without control should be avoided.

Recycle Material and Recycle Fuel

The Discussion Paper on Definition for Recycle Material and Recycle Fuel which we have seen identifies categories of material which may be judged to be at the interface between valued products and value-less wastes. The paper appears to indicate definitions for these categories of material which align them with the waste category definitions in draft Regulation 309, implying that increased control of these materials may be contemplated. From industry's viewpoint as a generator, the need for this is obscure, and we suggest that the increased imposition of record keeping and testing should be justified further.

We are pleased that the Blueprint recognizes that recycling cannot be mandated. We favour a system which includes realistic pricing for the various disposal options, with the belief that this will allow normal market forces to encourage increased recovery, recycling and reuse rather than disposal.

The Hearings Process

In Mr. Norton's address, one objective identifies consideration of the process involved in hearings and appeals. We strongly urge that improvements be developed. The present process, as implemented under the Consolidated Hearings Act to achieve the objectives of both the Environmental Protection Act and the Environmental Assessment Act, is perceived as being virtually unworkable if applied to projects in the private sector because of its length and its uncertainty.

A modified hearing process should have the potential to improve the quality of the decisions made and the confidence of all, including the public, in the results.

If the private sector is to be included in the hearing process, we suggest that the process be streamlined and shortened.

CONCLUSION

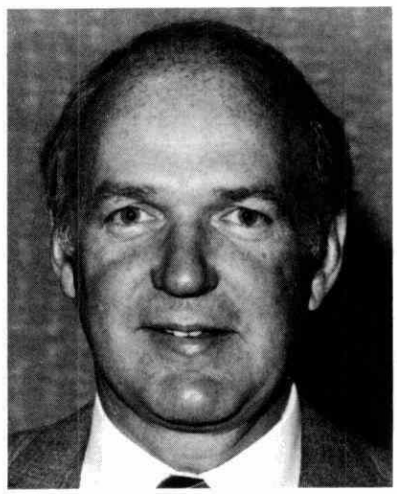
We support the thorough review of existing regulatory processes for waste disposal. We encourage you to continue to keep this visible to those of us who are affected, and to encourage special interest groups, and the true public, to contribute to the process. We urge you to build from techniques and legislative initiatives which have worked previously, and to learn from those which have not. We urge you to make a sincere effort to maintain compatibility with neighboring provinces and states.

We have offered some policy considerations, and some specific and detailed comments on four of the components of this system. We hope that these will be accepted constructively, and incorporated in the final Blueprint.

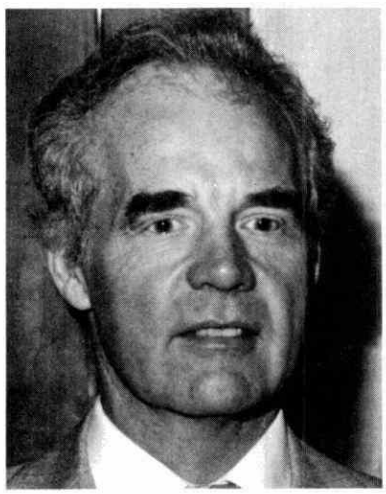
We feel that with some changes, the proposals which we have seen will fit into a system which can be made workable. We are encouraged by the number of points which match concerns and issues identified in the CCPA Position Paper.

Finally, we continue to offer our participation in discussions on the various elements of the system as they are developed further.

SESSION III – HAZARDOUS CONTAMINANTS

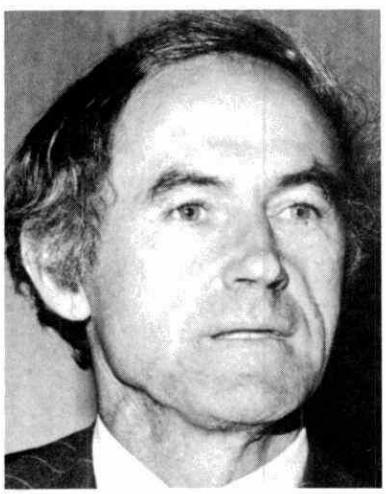


Chairman: G.H. Mills, Director,
West Central Region, Ontario
Ministry of the Environment,
Hamilton, Ontario



P. Crabtree, Niagara River Co-Ordinator,
Environment Ontario,
Hamilton, Ontario

A.F. Johnson, Trace
Contaminants Specialist, Hazardous Control Unit,
Water Resources Branch,
Environment Ontario, Toronto



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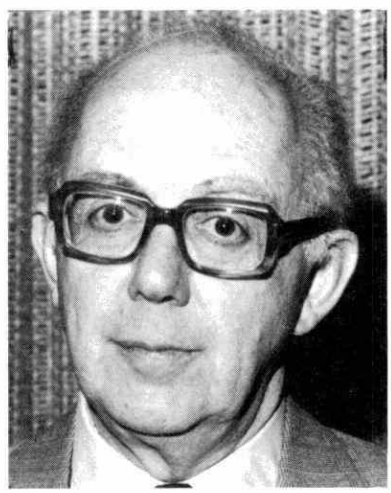

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NIAGARA RIVER--THE COMPLEXITIES OF CLEAN-UP

by

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This paper will describe the progress that has been made towards cleaning up the Niagara River, and will identify some of the tasks that remain to be done. The complexity of the issues involved will be emphasized through a review of the impacts of health, economic, social, political, and legal factors.

1. INTRODUCTION

The condition of the Niagara River continues to be a matter of concern to all residents of Ontario and New York State who depend on the River or Lake Ontario as a source of drinking water.

We can point to reductions in recent years in the levels of certain contaminants, such as phosphorus, DDT, mirex and PCB. At the same time, we recognise that chemical substances not previously identified in the river are being analysed in fish and sediments, sometimes in the water itself. On balance, therefore, it would be hard to say whether the river is improving or deteriorating, although it is clear that the banning or tight control of a particular substance can achieve the desired results of decreasing its presence in the environment.

For the present, we cannot gain an appreciation that progress is being made simply by analysing samples of water, sediments or fish. That extent of improvement is not going to be apparent in any general way for several years yet. Rather, we have to look for the prerequisites of that stage to see if they are in place; for example, we should ask:

- is there a comprehensive, coordinated and credible monitoring program in place to tell us, now and in the future, what substances are in the river and where they come from?

- are there control programs in place, both in Ontario and New York State, to deal effectively with chemical substances that are being discharged in unacceptable quantities?

- do we know the effects of the chemicals that are present in the river on aquatic life and human health?

- since the large majority of contamination entering the river comes from New York State, can we be sure that the United States is giving the level of priority and urgency to clean-up that we deem to be necessary?

2. FACTORS INFLUENCING ENVIRONMENTAL DECISIONS

Decisions that relate to protecting or cleaning up the environment are not made on the basis of the environmental factors alone. This is particularly true for the Niagara River. The international nature of the situation adds another element to the variety of influences normally present.

2.1 Health

The inter-relationship between environmental contamination and human health has long been recognised. Drinking water polluted by bacteria has, in past years, been the cause of sickness, dysentery and death. The change that has occurred this century is that we have learned to protect ourselves against that sort of acute toxic effect by installing treatment systems designed to remove suspended solids and destroy bacteria.

Today we are facing the challenge of a different form of water pollution. It is created by a range of chemical substances, made by man, that are present at low, or extremely low, levels. Their toxic effects are likely to be chronic rather than acute, and it is this factor that makes the linkage of a particular chemical with a certain health effect expensive and time consuming to establish. For example, the testing of a chemical for carcinogenic effects can cost upwards from $1 million, and take two years or more to complete. Added to this

limitation is the fact that the world's research capacity for this type of work could only cope, at any one time, with a small proportion of the chemicals presently without guidelines.

The levels at which chemicals without standards are found in the Niagara River are about the same or lower than the levels of chemicals for which standards exist. While this is no guarantee that all is well, most experts in the field of human health related to the environment suggest that there is nothing to indicate that there is an immediate risk. The long-term risk must be, and is being, addressed.

2.2 Economic

Protection of the environment from the waste products of today's society is expensive; correction of past errors and bad practices is even more expensive.

In facing this reality, we find points of view at both extremes. On the one hand, there is the argument that, because there are gaps in our knowledge of the health effects of many chemicals, their presence in the environment should be reduced to zero; cost is not a consideration. On the other hand, there is the view that, because we are in difficult economics times, priority must be given to jobs and investment in industry; extra expenditure on the environment must wait until conditions in the market place improve.

Neither extreme is acceptable. The environmental risks are too great to wait for an uncertain period for the economy to improve. Because of the length of lead time needed to put control and remedial measures in place, steps have been taken, and more must be taken yet, to make commitments to specific programs. But cost-effectiveness has to be an important criterion in the development of these programs, whether they be for monitoring (number of samples, locations, and analysis requirements have to be considered) or corrective measures (a range of options must be investigated).

Movements of population have a significant impact on the economic strength of a region. During the ten year period 1970-80, New York State experienced a reduction of 3.8% in its population, reflective of a general trend in the U.S. for people to move south to a warmer climate. Buffalo's population fell by a sharp 22.7% in the same time-frame. A number of industries in the area have closed down in recent years, with little chance that they will ever re-open. Inevitably, this situation has an effect on environmental programs, and stresses the need for a firm but balanced approach.

2.3 Social

The increasing flow of information on environmental issues from government agencies, academic institutions and interest groups has increased the awareness and knowledge of the general public. As a result, there is steady pressure on governments and industries to tighten the control of contaminated discharges. Much of this pressure is applied without the use of the law and its regulations, and, because it is disseminated through the communications media (nobody likes to receive adverse publicity), it can be very effective.

At the same time, there is a growing social conscience among our industries in the Niagara area, as elsewhere, which shows itself in a desire to be perceived as responsible corporate citizens. When infractions of discharge limitations are pointed out, many companies will move voluntarily to remedy the situation without the need for coercion by the Ministry of the Environment.

2.4 Political

Data published by both Canadian and U.S. sources indicate that more than 95% of the hazardous toxic contaminants entering the Niagara River originate on the American side. Therefore, if we are to attain our objective of having these discharges reduced significantly and quickly, we have to bring pressure on the appropriate level of government in the U.S., using technical, political or legal channels.

For Ontario, the political route has two alternatives. One is direct contact between the Minister of the Environment and the Commissioner for the Department of Environmental Conservation. This has been, and will continue to be, used to clear specific important high-profile blockages on issues that are within the jurisdiction of New York State (e.g. municipal and industrial discharge (SPDES) permits).

The other alternative is to utilise the diplomatic channels through the Dept. of External Affairs and Environment Canada to the U.S. State Department and Environmental Protection Agency (EPA). This is the option for issues that are within EPA's jurisdiction, such as U.S. federal litigation on waste disposal sites, Superfund allocations or the Clean Water Act. If appropriate, it can be supplemented by direct contacts between the Minister of the Environment and the E.P.A. Administrator.

Of particular interest is the use that has been made of the diplomatic channel in the last six months to try to develop a negotiation process between the U.S. and Canada that will give us access to technical information on waste sites under litigation, and also a means to have an impact on the decisions for clean-up actions. In light of the confidentiality that necessarily envelopes court cases, this will be a major change in procedure if it can be achieved. Only time will tell.

2.5 Legal

There is a greater tendency in the United States than in Canada to resort to the courts for the resolution of environmental problems. Regardless of our views of the merits of an adversarial approach compared with a cooperative one, we have had to familiarise ourselves with the U.S. litigative process in order to be able to play our part.

The four most widely publicized waste disposal sites in the Niagara area (Love Canal, Hyde Park, S-Area and 102nd Street) are all before the federal court in Western New York. Hooker Chemical's "Alphabet" sites and Durez (N. Tonawanda)

property are subject to state litigation. The discharge (SPDES) permit for the Niagara Falls (NY) Wastewater Treatment Plant is being challenged in a state court by the Industrial Liaison Committee of the Niagara Falls Chamber of Commerce and by the Sierra Club. In each of these instances, we have prepared ourselves for the appropriate form of intervention, should the need arise for protecting Ontario's interests.

The announcement in the Ontario legislature on June 9, 1983, by the Minister of the Environment, the Hon. K.C. Norton, is an example of our use of the U.S. legal system. He indicated that Ontario would seek intervenor status in the S-Area case; if the request is granted by the court, this will make us a party in the litigation process with access to the information available to the other parties, and the chance to make our views known.

3. PROGRESS TO DATE

I shall outline the achievements of Ontario's program for the Niagara River up to this point by responding to the questions I posed in the Introduction.

3.1 Monitoring

"Is there a comprehensive, coordinated and credible monitoring program in place?"

Ontario and Canada have had a comprehensive monitoring program in place since the early 1970s, progressively covering water, fish, plant and sediment sampling. The first step to coordinate this work with U.S. efforts was taken early in 1981 when the Niagara River Toxics Committee (NRTC) was established; this group consists of federal, state and provincial scientists and engineers from both countries. The Committee is scheduled to report its findings at the end of 1983, including recommendations for a long term monitoring program. During the last two years, some difficulties in creating such a long-term program have come to light (for

example, the differences in detection limits used in the two countries, and the very low levels at which many of the chemicals exist in water, making their detection in quantifiable terms hard to achieve).

The effect of the intensive monitoring being done is that we now know which chemicals are present in the river, we are close to putting them in a priority framework, and we are identifying our gaps in sampling and analytical procedures. When the N.R.T.C. reports, we can anticipate having a proposal that will meet the criteria of being comprehensive, coordinated and credible.

3.2 Discharge Permits

"Are there control programs to deal effectively with discharges containing chemical substances in unacceptable quantities?"

For point source discharges there are control program frameworks in place on both sides of the border. In Ontario we have Certificates of Approval and Control Orders; in New York, there are State Pollution Discharge Elimination System (SPDES) permits and Consent Agreements. As control systems, both can be effective provided they are stringent enough in their criteria, and are enforced.

There are similar control mechanisms for landfill sites in operation today. These are not the problem, however. It is the clean-up of existing inactive waste disposal sites that is the real challenge; this situation is reviewed in response to question four below (see Sect. 3.4).

3.3 Effects of Chemicals

"Do we know the effects on aquatic life and human health of the chemicals that are present in the river?"

Arising out of the intensive monitoring work in the Niagara River now in progress is a clearer picture of the extent of our knowledge in this area, and of the gaps in that knowledge.

Since the first step in the process of improvement is the identification of gaps, and the setting of priorities for filling them, we can be said to be making progress. The Niagara River Toxics Committee is carrying out these tasks, as part of the terms with which it was charged, and the Committee's report to be issued at the end of 1983 will contain this information. From that point on, it will rest with the four governments involved to authorize the research needed to develop the aquatic and health standards that do not presently exist.

3.4 Degree of Urgency

"Is the United States treating clean-up of the Niagara River with sufficient urgency?"

In terms of the speed at which we in Canada want to have the water quality of the river improved, progress is too slow. It will be several years yet before we will be able to measure a quantitative reduction in the total chemical loading. This is partly, of course, because of the long lead time required by any control program to take effect - but it's also because in too many situations there have been, and still are, lengthy delays in putting effective control programs in place (for example, the Niagara Falls (NY) Wastewater Treatment Plant broke down in 1978 and will not be fully operational until 1986; the S-Area waste disposal site has been under negotiation in federal court for nearly three years, and there is still no agreement on the remedial action to be taken).

As I mentioned earlier, there is more tendency to use litigation for the resolution of environmental issues in the U.S. than in Canada. The result is often delays that run into many years. Canada's view is that, because the Niagara River is an international waterway subject to a treaty between the two countries agreeing to the prevention of transboundary pollution, special measures should apply. The normal domestic procedures of either country should not be allowed to stand in the way of the quickest possible means to remove sources of pollution.

Therefore, to assess whether the U.S. is giving a high level of priority to the Niagara River, we look for special measures being taken to expedite existing control programs or create new ones. Sometimes there is evidence, such as the decision in May this year to use Super Fund money to start monitoring work at S-Area, that EPA is prepared to do this. All too often, this does not happen and the much needed action is held up.

The last two to three years have seen some improvement in the appreciation by the United States of Canadian feelings about the Great Lakes in general and the Niagara River in particular. If we are to ensure that this trend is maintained and increased, we shall need constant vigilance and persistence.

Let's look now at where our future efforts may be directed.

4. STILL TO BE DONE

I perceive a number of steps that remain to be taken before we can say that the Niagara River is on its way to the sort of long term improvement that can be maintained. The following will need to be implemented:

a. continuous reviews of SPDES permits and Certificates of Approval to ensure water quality standards are met on both sides of the border. Up-grading should be done as technology for detection and treatment improves.

b. regular reviews of the effectiveness of waste site remedial programs, and implementation of further work if necessary.

c. a mass balance plan to establish all inputs of contaminants to the river (point and non-point sources and Lake Erie), and to equate the sum of those inputs to the output into Lake Ontario.

d. a long term monitoring program for the river with two objectives, (i) to trace trends for specific chemicals that reflect changes in the overall quality of the river, and

(ii) to keep a check on the discharges from known point and non-point sources of a problem nature.

e. further control programs based on needs identified by the Niagara River Toxics Committee's work or the long term monitoring program.

f. an effective negotiation process between Canada and the United States which permits a full flow of environmental information in both directions, and a reasonable chance to influence decisions on control programs and clean-up actions, outside the jurisdiction of the courts.

5. SUMMARY

In the last few years, a great deal of monitoring work has been done in the Niagara River. We are gaining a clearer picture of the extent and complexity of the problem we face in order to reverse the environmental deterioration of several decades.

Control programs are in place for certain point sources and waste disposal sites which, given time and proper enforcement, should be effective in meeting their goals.

The level of awareness of the issues has been raised in the minds of the public and of governments. There is a growing appreciation that a sustained effort will be needed for many years; more monitoring, more control and more close international cooperation hold the key to ultimate success.

Hazardous Contaminants in Sport Fish: 6 Years of Testing and Public Advisories in Ontario

by: Allan F. Johnson,
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Environment Ontario

It has become very fashionable to talk of "Hazardous Contaminants" in the aquatic environment as if contamination were a peril that has only just recently been discovered.

In fact, water pollution by toxic substances was mentioned by that greatest of all angling writers, Izak Walton, in his classic book. "The Compleat Angler". Writing in 1653, at a time when the 17th century version of the Cruise missile, Oliver Cromwell and his New Model Army, was marching through England, Walton pointed out that there was "a river in Epirus that puts out any lighted torch, and kindles any torch that was not lighted. Some waters being drunk cause madness, some drunkenness, and some laughter to death".

Not only did Izak Walton write about water pollution 330 years ago, he mentioned that certain kinds of fish had "bad flesh" at certain times of the year, and should not be eaten. And that brings us to the subject of contaminants in the edible portion of Ontario sport fish.

In Ontario, we have been blessed with almost immeasurable riches in terms of the variety and numbers of game fish. No one knows exactly how many lakes there are in Ontario - at least 250,000. And the lake trout, speckled trout, northern pike, walleye, pickerel, muskellunge, bass-all species of fish which provide much sport and good eating.

But a dozen years ago this fisherman's paradise was lost, apparently in some minds, forever, with the utterance of a single word - pollution. We didn't call them hazardous contaminants then. We were not sophisticated or learned. We called it mercury---others called it poison, Minimata disease, racial genocide. When we found insecticides such as DDT, the same things were said. And then came PCB's-an industrial lubricant and insulating fluid, and mirex, an insecticide and fire-retardant additive. And the public viewed all this as polluting, for all time, our finest fishing waters and most prized fish species.

While the public perception was not entirely accurate, it did result in a widely held belief that one could not eat fish taken from most if not all of Ontario's waters. Inevitably the government of the day was critized for allowing the degradation of the environment and loss of sporting opportunities and tourist dollars.

Between 1970 and 1976, studies of mercury, pesticides and organic chemicals such as PCB in fish were undertaken in the vicinity of industries, mining sites, areas of natural mineral deposits, commercial fishing areas, and lakes used as a source of food supply by Ontario's native peoples. Samples from some popular angling waters were analyzed as well.

By 1976, it was decided that the accumulated data were not only useful to scientists and pollution control engineers for scientific monitoring and research but, if health-related guidelines for the safe consumption of fish were also available, these data could be used to answer the many public enquiries about the state of the aquatic environment and the safety of consuming fish from particular lakes.

The Fish Contaminant Program

Accordingly, a program was initiated to assess all statistically reliable fish contaminant data and publish them in a widely available public format. At the same time, a program to test as many popular angling waters as possible was initiated.

The Fish Contaminant Monitoring Program operates as a co-ordinated undertaking of the Ontario ministries of Environment, Natural Resources, and Labour.

Fish are collected primarily by staff of the Ministry of Natural Resources. Scientists from the Ministry of the Environment analyze the fish samples for various contaminants and assess the findings in relation to the health significance of each contaminant provided by medical specialists in the Ministry of Labour. The information is then published in the "Guide to Eating Ontario Sport Fish". Depending on when particular sets of analyses become available, they are normally released first in the MOE Environmental Health Bulletin and subsequently in the following year's guide books.

Selection of Lakes for Testing

With over 250,000 lakes, uncounted rivers and streams and the many local areas in the Great Lakes, it would not be practical or economical to carry out testing on each and every water body. Nearly 1,200 locations have been tested and reported on in the past six years. Selection of waterbodies to be tested is an on-going process and public input is welcomed so that information will be available to answer public concerns. Citizens who wish to have fish tested from a lake or river which does not appear in the Guide are invited to write to their local office of the Ministry of Natural Resources or Environment with their specific request. The lakes to be tested are selected by staff of the Ministry of the Environment and Natural Resources for one or more of the following reasons:

- a popular angling area
- a known or suspected source of pollution nearby
- a major source of food for local inhabitants (usually lakes in the vicinity of Indian Reserves)
- a commercial fishery
- lakes being open for recreational development
- monitoring program for long-term studies of contaminants in fish.

Selection of Fish Species for Testing

Most lakes and rivers contain a variety of fish species. When selecting appropriate species for contaminant testing it should be noted that not all species accumulate a particular contaminant at the same rate. Therefore, one kind of fish at a certain size may have a much lower contaminant concentration than another species of the same size. This is due, in part, to the fact that different fish feed on different things, have a variety of habitats, grow at different rates and are physiologically different.

For example, fish such as walleye (yellow pickerel) and northern pike are likely to contain higher levels of mercury than a species such as whitefish at the same size since walleye and pike are "top predators" feeding on smaller fish which also may contain elevated mercury levels. The whitefish, on the other hand, feeds lower down the "food chain" on aquatic insects and invertebrates which contain less mercury than small fish. It is, therefore, a practice when testing fish in specific areas for mercury, to test those species in a lake which are "top predators" as they will indicate the highest mercury levels. If low levels are found in predators, testing of other species may not be required.

In testing for organic contaminants such as PCB (an industrial lubricant and insulating fluid now strictly controlled) and mirex (a fire-retardant additive and pesticide that is no longer used), it is most appropriate to test species of fish such as salmon, lake trout, smelt and perch with high fat levels in the flesh. Organic contaminants usually tend to accumulate in fatty tissue.

Collection and Testing of Fish

Most fish are collected by staff of the Ministry of Natural Resources using various netting methods. In some cases, fish are sampled from a commercial fisherman's catch. Whenever possible, the collection includes 15 to 20 fish of each species with lengths and weights representative of the size range of that species from the lake being tested. The length, weight and sex of each fish collected are recorded. In some cases, scale samples are taken so that the age of the fish can be determined. A boneless, skinless fillet of dorsal muscle flesh is removed from the fish, packaged and frozen for shipment to the Ministry of the Environment laboratories in Toronto.

Experience with the testing of fish samples over the past 15 years has shown that a boneless, skinless dorsal fillet sample provides more consistent results than other tissue types. This portion of the fillet also represents the choicest edible part of most sport fish. Where contamination by organic substances such as PCB, mirex is confirmed, it is recommended that only the boneless, skinless dorsal fillet be consumed.

Analysis of fish tissue for contaminants at the laboratories of the Ministry of the Environment is done by a variety of methods depending on the paticular contminants of interest. Mercury testing is done by automated flameless atomic absorption spectrophotometry. Organics such as PCB, mirex and organochlorine pesticides (DDT, aldrin, chlordane, etc.) are measured by gas chromatography. Special analysis for 2,3,7,8-TCDD) (dioxin) at levels of a few parts per trillion is done by combined gas chromatography mass spectrometry technique. Depending on the method used, the cost of each analysis can range from a few dollars (for mercury) to several hundred dollars (for 2,3,7,8-TCDD) for each analysis.

After analysis, the results, together with the physical information collected on each fish are used to develop the tables outlining size-specification consumption advice for each species form each waterbody. Contaminant values for each size of fish are calculated and these are compared with medical advice on the significance of a contaminant to human health as reflected in the appropriate Canadian government health protection guidelines.

After data from the laboratories have been evaluated and the consumption advice for that size and species of fish determined, it is made public by means of regular Environmental Health Bulletins published by the Ministry of the Environment and sent to all new media outlets. Each spring the updated version of the "Guide to Eating Ontario Sport Fish" is published.

Location identification

Lake names, latitude and longitude, and township, county or territorial district information are obtained from the Gazeteer of Canada (Ontario), published by Energy, Mines, and Resources Canada (1974). For those lakes not listed in the Gazeteer, field staff responsible for the fish collection supply the information.

Information from the Great Lakes is broken down according to statistical districts defined by the Ministry of Natural Resources. Where possible, separate collections from an individual statistical district are identified according to specific location of capture of the fish.

Consumption guidelines

The guidelines reflect the maximum recommended consumption of fish according to contaminant content and duration of fishing vacation - one-week, two-weeks, three-weeks, and more than three weeks. Fishing holidays should be spaced at least six months apart if the maximum number of meals recommended for fish indicated by limited consumption symbols has been consumed.

Laboratory analyses are carried out on lean, dorsal muscle tissue and the consumption guidelines are based on this portion of the fish. Persons consuming fish prepared in other ways (eg. whole fish, fish steaks, portions with skin and bone intact, etc.) should be aware that the contaminants PCB, mirex, DDT and 2,3,7,8-TCDD associate with fatty tissue and may be at higher concentrations in the whole fish, fish steaks, etc. than in the sample tested.

Children under 15 years of age and women of childbearing age should eat only fish in the unrestricted catagory.

Checking Fish For Contaminants

1. Identify the species.
2. Measure length of fish from the tip of the nose to the tip of the tail.
3. Check the tables for the appropriate lake.
4. Note the symbol for the particular fish you are checking.
5. Determine the consumption recommendations from the appropriate consumption guidelines table.

The Results of the Testing Program

In reviewing the consumption advice for various locations in the Province as shown in the tables of the "Guide to Eating Ontario Sport Fish", it can be seen that there are many locations which show levels of mercury which are entirely natural and levels of PCB, mirex and DDT which are entirely within Federal government guidelines.

There are others which, in the past, have indicated high contaminant levels as a result of a particular source of pollution.

Mercury

The classic example of this is the English - Wabigoon River system in Northwestern Ontario. Changes in the consumption advice for Walleye, Northern Pike and Whitefish from Clay, Ball, Separation and Tetu Lakes show a gradual lowering in the mercury levels in these three species is occurring. In 1978, limited commercial fishing by native groups was re-established.

This decline in mercury in fish has also occurred in the Lake St. Clair system in the Great Lakes. There, commercial fishing for coarse fish was re-established after a 10 year moratorium.

PCB

Levels of PCB in Lake trout from locations in Lake Superior are now below the 2.0 ppm Federal guideline. The same is true for Rainbow trout from Southern Georgian Bay. There are still suggested limitations on the consumption of salmon and large trout from Lake Ontario because of elevated PCB levels.

Mirex

Mirex as a contaminant limiting consumption of salmon and trout is only important in Lake Ontario.

DDT

Once a contaminant of concern in Ontario, DDT levels in fish flesh have declined to the point where there are no fish tested in recent years which exceed the 5.0 ppm maximum allowable level.

2,3,7,8-TCDD (Dioxin)

Studies up to the present have shown that of the fish tested from various Great Lakes, only Lake Trout longer than 45 cm (18 inches) collected from the Western basin of Lake Ontario have been found to exceed the 20 ppt Federal guideline.

Conclusion

While there are fish species in a number of Ontario waters for which limited consumption guidelines are advised, there has been significant improvement in the edibility of sport fish from a number of locations where pollution sources were identified and control action has been taken.

Consumption Guidelines

One week	No restrictions	10 meals per wk. 2.3 kg./wk. (5.1 lb./wk.)	7 meals per wk. 1.54 kg./wk. (3.4 lb./wk.)	1 or 2 meals/wk. 0.45 kg./wk. (1 lb./wk.)	None
Two weeks	No restrictions	5 meals per wk. 1.3 kg./wk. (2.8 lb./wk.)	4 meals per wk. 0.86 kg./wk. (1.9 lb./wk.)	1 or 2 meals/wk. 0.45 kg./wk. (1 lb./wk.)	None
Three weeks	No restrictions	4 meals per wk. 0.95 kg./wk. (2.1 lb./wk.)	3 meals per wk. 0.63 kg./wk. (1.4 lb./wk.)	1 or 2 meals/wk. 0.45 kg./wk. (1 lb./wk.)	None
Long term consumption	No restrictions	0.226 kg./wk. (0.5 lb./wk.)	0.136 kg./wk. (0.3 lb./wk.)	1 or 2 meals per month 0.45 kg./mo. (1 lb./mo.)	None

Guide de consommation

Une semaine	Pas de restrictions	10 repas par sem. 2,3 kg/sem. (5,1 lb./sem.)	7 repas par sem. 1,54 kg/sem. (3,4 lb/sem.)	1 ou 2 repas par sem. 0,45 kg/sem. (1 lb/sem.)	Aucun
Deux semaines	Pas de restrictions	5 repas par sem. 1,3 kg/sem. (2,8 lb/sem.)	4 repas par sem. 0,86 kg/sem. (1,9 lb/sem.)	1 ou 2 repas par sem. 0,45 kg/sem. (1 lb/sem.)	Aucun
Trois semaines	Pas de restrictions	4 repas par sem. 0,95 kg/sem. (2,1 lb/sem.)	3 repas par sem. 0,63 kg/sem. (1,4 lb/sem.)	1 ou 2 repas par sem. 0,45 kg/sem. (1 lb/sem.)	Aucun
Consommation à long terme	Pas de restrictions	0,226 kg/sem. (0,5 lb/sem.)	0,136 kg/sem. (0,3 lb/sem.)	1 ou 2 repas par mois 0,45 kg/mois (1 lb/mois)	Aucun

Contaminant identification		Identification des polluants
1	Mercury	Mercure
2	Mercury, PCB, mirex and pesticides	Mercure, PCB, mirex et pesticides
3	PCB, mirex and pesticides	PCB, mirex et pesticides
4	Mercury, PCB and mirex	Mercure, PCB et mirex
5	Mercury, other metals, PCB, mirex and pesticides	Mercure, autres métaux, PCB, mirex et pesticides
6	Mercury, other metals	Mercure et autres métaux
7	2,3,7,8-TCDD (Dioxin)	2,3,7,8-TCDD (dioxine)
8	Toxaphene	Toxaphène

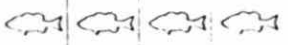
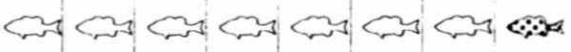
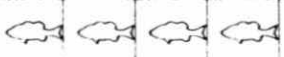
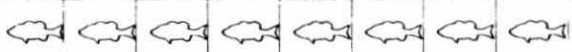
Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) / Longueur du poisson en centimètres (pouces) 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	- 75 (30)
Silver Lake / Lac Silver 4450/7636 S. Sherbrooke Twp Canton de S. Sherbrooke Lanark Co. / Cté de Lanark										
Smallmouth Bass[4] Achigan à petite bouche[4]										
Northern Pike[1] Brochet[1]										
White Sucker[1] Meunier noir[1]										
Lake Simcoe / Lac Simcoe 4425/7920 Simcoe Co., York & Durham R.M.'s Cté de Simcoe, M.R.'s d'York et Durham										
Largemouth Bass[1] Achigan à grande bouche[1]										
Smallmouth Bass[2] Achigan à petite bouche[2]										
Yellow Perch[2] Perchaude[2]										
Northern Pike[2] Brochet[2]										
Walleye[2] Doré[2]										
Lake Trout[2] Truite de lac[2]										
White Sucker[1] Meunier noir[1]										
Whitefish[2] Grande corégone[2]										
Rock Bass[1] Crapet de roche[1]										
Ling[2] Lotte[2]										

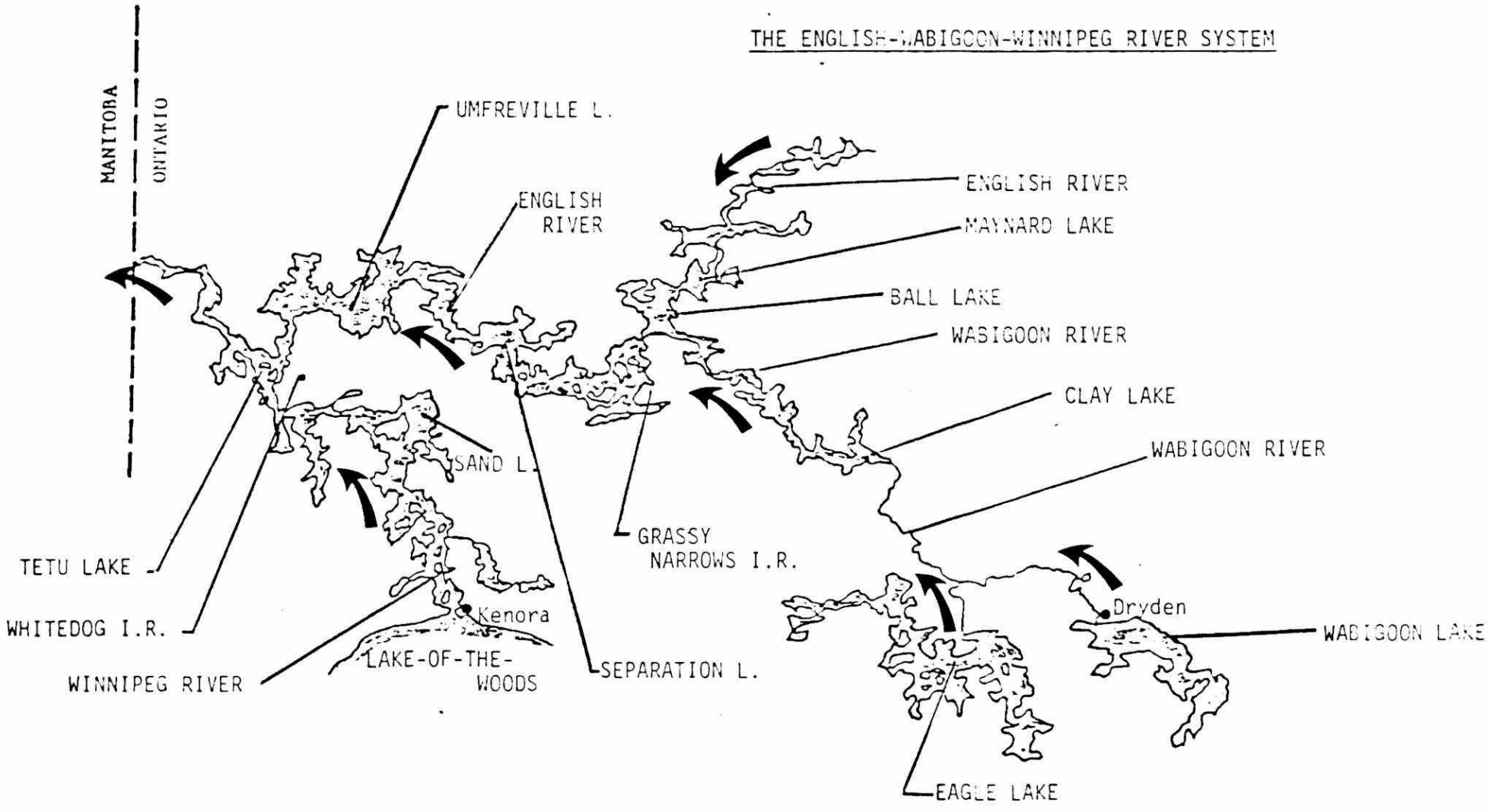
Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) Longueur du poisson en centimètres (pouces) 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	75 (30)
Stony Lake **Lac Stony** 4433/7806 Burleigh & Dummer Twps Cantons de Burleigh et Dummer Peterborough Co. / Cté de Peterborough										
Walleye[1] Doré[1]										
Yellow Perch[1] Perchaude[1]										
Ling[1] Lotte[1]										
Cisco[1] Cisco de lac[1]										
Smallmouth Bass[2] Achigan à petite bouche[2]										
Muskie[2] Maskinongé[2]										
Sturgeon Lake **Lac Sturgeon** 4428/7843 Fenelon Twp. / Canton de Fenelon Victoria Co. / Cté de Victoria										
Smallmouth Bass[2] Achigan à petite bouche[2]										
Walleye[2] Doré[2]										
Yellow Perch[2] Perchaude[2]										

Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) / Longueur du poisson en centimètres (pouces) 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	75 (30)
(Lower) Niagara River Rivière (Bas) Niagara Queenston 4310/7903 Niagara R.M./M.R. de Niagara										
American Eel[5,7] Anguille d'Amérique[5,7]							✓	✓	✓	✓
Yellow Perch[2,7] Perchaude[2,7]		✓	✓	✓						
Walleye[7] Doré[7]							✓			
Rainbow Trout[7] Truite arc-en-ciel[7]								✓		
Northern Pike[7] Brochet[7]							✓			
Muskie[7] Maskinongé[7]								✓		
White Sucker[5] Meunier noir[5]				✓	✓	✓	✓			
Coho[3] Saumon coho[3]								✓	✓	✓
Rock Bass[7] Crapet de roche[7]		✓	✓							
Smallmouth Bass[5,7] Achigan à petite bouche[5,7]		✓	✓	✓	✓	✓				
(Upper) Niagara River Rivière (Supérieur) Niagara Miller Creek/Ruisseau Miller 4258/7857 Niagara R.M./M.R. de Niagara										
Smallmouth Bass[5,7] Achigan à petite bouche[5,7]			✓	✓	✓	✓				
Yellow Perch[2,7] Perchaude[2,7]		✓	✓	✓						
White Sucker[2,7] Meunier noir[2,7]			✓	✓	✓	✓	✓			

Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) / Longueur du poisson en centimètres (pouces) 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	75 (30)
Lake Ontario #1 **Lac Ontario #1** Credit River/Rivière Credit 4333/7935 Peel R.M./M.R. de Peel										
Coho[5,7] Saumon coho[5,7]										
White Bass[2] Bar blanc[2]										
Rainbow Trout[4] Truite arc-en-ciel[4]										
Lake Trout[3,7] Truite de lac[3,7]										
Lake Ontario #1 **Lac Ontario #1** Humber Bay area Environs de Baie Humber 4337/7927 Metro Toronto/Grand Toronto										
Rainbow Smelt[5,7] Éperlan arc-en-ciel[5,7]										
Lake Trout[2,7] Truite de lac[2,7]										
White Sucker[5,7] Meunier noir[5,7]										
Rainbow Trout[2,7] Truite arc-en-ciel[2,7]										
Brown Bullhead[2] Barbotte brune[2]										
White Bass[2] Bar blanc[2]										
Yellow Perch[2] Perchaude[2]										
Northern Pike[2] Brochet[2]										
Carp[5] Carpe[5]										
Largemouth Bass[2] Achigan à grande bouche[2]										

Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) / Longueur du poisson en centimètres (pouces) 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	75 (30)
Lake Erie #2 **Lac Erie #2** Rondeau Bay/Baie Rondeau 4217/8153 Kent Co./Cté de Kent										
Northern Pike[1] Brochet[1]										
Black Crappie[1] Marigane noire[1]										
White Crappie[1] Marigane blanche[1]										
Bluegill[2] Crapet arlequin[2]										
Largemouth Bass[2] Achigan à grande bouche[2]										
Lake Erie #3 **Lac Erie #3** Port Stanley 4240/8113 Yarmouth Twp./Canton d'Yarmouth Elgin Co./Cté d'Elgin										
Coho[2] Saumon coho[2]										
White Bass[2] Bar blanc[2]										
Yellow Perch[1] Perchaude[1]										
Freshwater Drum[1] Malachigan[1]										
Rainbow Smelt[2] Éperlan arc-en-ciel[2]										

Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) / Longueur du poisson en centimètres (pouces) 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	75 30
Georgian Bay GB #3 **Baie Georgian GB #3** Halo Island, Moon River Île Halo, Rivière Moon 4507/8003 Parry Sound Dist /Dist de Parry Sound										
Smallmouth Bass[1] Achigan à petite bouche[1]										
Georgian Bay GB #4 **Baie Georgian GB #4** Pyette Point to Cape Commodore Pointe Pyette à Cap Commodore 4445/8053 Keppel Twp /Canton de Keppel Grey Co /Cté de Grey										
Rainbow Trout[2] Truite arc-en-ciel[2]										
Georgian Bay GB #4 **Baie Georgian GB #4** Owen Sound Cape Rich Thornbury 4443/8038 Grey Co /Cte de Grey										
Rainbow Trout[2,7] Truite arc-en-ciel[2,7]										
Splake[2] Splake[2]										
Bloater[2] Cisco de fumage[2]										
White Sucker[2] Meunier noir[2]										
Yellow Perch[2] Perchaude[2]										
Georgian Bay GB #4 **Baie Georgian GB #4** Indian Brook/Ruisseau Indian 4433/8025 Collingwood Twp Canton de Collingwood Grey Co /Cté de Grey										
Rainbow Trout[2] Truite arc-en-ciel[2]										


THE ENGLISH-WABIGOON-WINNIPEG RIVER SYSTEM
MANITOBA
ONTARIO
UMFREVILLE L.
ENGLISH RIVER
ENGLISH RIVER
MAYNARD LAKE
BALL LAKE
WABIGOON RIVER
CLAY LAKE
WABIGOON RIVER
SAND L.
GRASSY NARROWS I.R.
TETU LAKE
WHITEDOG I.R.
WINNIPEG RIVER
Kenora
LAKE-OF-THE-WOODS
SEPARATION L.
Dryden
WABIGOON LAKE
EAGLE LAKE

A

Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) Longueur du poisson en centimètres (pouces) 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	+ 75 (+30)
Tetu Lake 1983 **Lac Tetu** 5011/9502 Kenora Dist./Dist. de Kenora										
Walleye[1] Doré[1]										
Northern Pike[1] Brochet[1]										
Sauger[1] Doré noir[1]										
Cisco[1] Cisco de lac[1]										
White Sucker[1] Meunier noir[1]										
Sturgeon[1] Esturgeon de lac[1]										
Whitefish[1] Grande corégone[1]										
Tetu Lake 1982 **Lac Tetu** 5011/9502 Kenora Dist./Dist. de Kenora										
Walleye[1] Doré[1]										
Northern Pike[1] Brochet[1]										
Sauger[1] Doré noir[1]										
Cisco[1] Cisco de lac[1]										
White Sucker[1] Meunier noir[1]										
Sturgeon[1] Esturgeon de lac[1]										

Waterbody / Cours d'eau	Fish size in centimetres (inches) Longueur du poisson en centimètres (pouces)									
Fish Species / Espèces de poisson	< 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	> 75 (30)
Separation Lake 1982 **Lac Separation** 5014/9424 Kenora Dist./Dist. de Kenora										
Redhorse Sucker[1] Suceur rouge[1]										
Northern Pike[1] Brochet[1]										
Mooneye[1] Laquaiche argentée[1]										
Walleye[1] Doré[1]										
Whitefish[1] Grande corégone[1]										
Cisco[1] Cisco de lac[1]										
Sauger[1] Doré noir[1]										
White Sucker[1] Meunier noir[1]										
Ling[1] Lotte[1]										
Yellow Perch[1] Perchaude[1]										
Separation Lake 1983 **Lac Separation** 5014/9424 Kenora Dist./Dist. de Kenora										
Redhorse Sucker[1] Suceur rouge[1]										
Northern Pike[1] Brochet[1]										
Mooneye[1] Laquaiche argentée[1]										
Walleye[1] Doré[1]										
Whitefish[1] Grande corégone[1]										
Cisco[1] Cisco de lac[1]										
Sauger[1] Doré noir[1]										
White Sucker[1] Meunier noir[1]										
Ling[1] Lotte[1]										
Yellow Perch[1] Perchaude[1]										

Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) / Longueur du poisson en centimètres (pouces) 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	+ 75 (30)
Bad Vermilion Lake **Lac Bad Vermilion** 4844/9240 Rainy River Dist./Dist. de Rainy River										
Northern Pike[1] Brochet[1]										
Walleye[1] Doré[1]										
Ball Lake **Lac Ball** **1982** 5018/9400 Kenora Dist./Dist. de Kenora										
Northern Pike[1] Brochet[1]										
Walleye[1] Doré[1]										
Whitefish[1] Grande corégone[1]										
White Sucker[1] Meunier noir[1]										
Mooneye[1] Laquaiche argentée[1]										
Yellow Perch[1] Perchaude[1]										
Sauger[1] Doré noir[1]										
Smallmouth Bass[1] Achigan à petite bouche[1]										
Cisco[1] Cisco de lac[1]										
Ball Lake **Lac Ball** **1983** 5018/9400 Kenora Dist./Dist. de Kenora										
Northern Pike[1] Brochet[1]										
Walleye[1] Doré[1]										
Whitefish[1] Grande corégone[1]										
White Sucker[1] Meunier noir[1]										
Mooneye[1] Laquaiche argentée[1]										
Yellow Perch[1] Perchaude[1]										
Sauger[1] Doré noir[1]										
Smallmouth Bass[1] Achigan à petite bouche[1]										
Cisco[1] Cisco de lac[1]										

Waterbody / Cours d'eau Fish Species / Espèces de poisson	Fish size in centimetres (inches) / Longueur du poisson en centimètres (pouces) ≤ 15 (6)	15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	> 75 (30)
Claire Lake / Lac Claire 4937/8437 Arnott Twp./Canton d'Arnott Algoma Dist./Dist. d'Algoma										
Speckled Trout[1] / Truite mouchetée[1]										
Clarice Lake / Lac Clarice 4820/7932 Pontiac Twp./Canton de Pontiac Timiskaming Dist./Dist. de Timiskaming										
Lake Trout[1] / Truite de lac[1]										
Clay Lake / Lac Clay **1982** 5003/9330 Redvers Twp./Canton de Redvers Kenora Dist./Dist. de Kenora										
Walleye[2] / Doré[2]										
Northern Pike[2] / Brochet[2]										
Whitefish[2] / Grande corégone[2]										
Clay Lake / Lac Clay **1983** 5003/9330 Redvers Twp./Canton de Redvers Kenora Dist./Dist. de Kenora										
Walleye[2] / Doré[2]										
Northern Pike[2] / Brochet[2]										
Whitefish[2] / Grande corégone[2]										

THE ONTARIO MINISTRY OF THE ENVIRONMENT

ROLE IN MUTAGENICITY TESTING

by

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LABORATORY SERVICES AND APPLIED RESEARCH BRANCH
ONTARIO MINISTRY OF THE ENVIRONMENT

MUTAGENICITY TESTING HAS BECOME ANOTHER USEFUL TOOL IN ENVIRONMENTAL MONITORING. IT IS PRIMARILY USED TO ISOLATE AND IDENTIFY MUTAGENIC AND CARCINOGENIC COMPOUNDS IN THE ENVIRONMENT, AND TO MEASURE THE POTENCY OF SPECIFIC GENOTOXIC HAZARDS. IN THE COURSE OF THIS PRESENTATION I WILL REVIEW THE FOLLOWING FOUR ASPECTS OF THE ENVIRONMENT MINISTRY'S MUTAGENICITY TESTING PROGRAM:

1. THE MINISTRY'S ROLE IN MUTAGENICITY TESTING.
2. ALTERNATIVE TEST SYSTEMS.
3. INTERPRETATION OF TEST DATA.
4. FUTURE DIRECTIONS IN MUTAGENICITY TESTING.

MINISTRY GOAL

THE ACTIVITIES OF THE MINISTRY IN THE AREA OF MUTAGENICITY TESTING ILLUSTRATES THE WIDE-RANGING DIMENSIONS OF THE MINISTRY'S MANDATE TO PROTECT THE ENVIRONMENT. THE BROAD SCOPE OF THIS MANDATE IS BEST DEFINED BY THE MINISTRY GOAL STATEMENT:

> "TO ACHIEVE AND MAINTAIN A QUALITY OF THE ENVIRONMENT - INCLUDING AIR, WATER AND LAND - THAT WILL PROTECT HUMAN HEALTH AND THE ECOSYSTEM AND WILL CONTRIBUTE TO THE WELL-BEING OF THE PEOPLE OF ONTARIO."

THE KEY COMPONENT OF THAT STATEMENT IS THE LINKING OF ENVIRONMENTAL PROTECTION AND ENHANCEMENT WITH ITS IMPACT UPON THE TOTAL ECOSYSTEM, INCLUDING MAN. THIS LINKAGE BETWEEN ENVIRONMENTAL PROTECTION AND MAN'S WELL-BEING LEADS US INTO THE AREA OF ENVIRONMENTAL HEALTH. ENVIRONMENTAL HEALTH IS AN INTEGRAL PART OF THE CONTINUUM LINKING THE NATURAL ENVIRONMENT AND MAN. IT FOLLOWS THEN, THAT THE

MAINTENANCE OF A HEALTHY NATURAL ENVIRONMENT WILL BRING IN ITS TRAIN THE CONDITIONS WHICH WILL ENSURE THE PROTECTION OF THE HEALTH OF THE COMMUNITY AT LARGE.

ENVIRONMENTAL HEALTH

THERE ARE MANY WAYS OF DEFINING ENVIRONMENTAL HEALTH. TO ILLUSTRATE, THERE IS THE BROAD DEFINITION:

> "THOSE ASPECTS OF THE HEALTH OF THE GENERAL PUBLIC AFFECTED BY ANY EXTRANEOUS AGENT PRESENT IN THE ENVIRONMENT, INCLUDING LIFE STYLE FACTORS."

THE DIFFICULTY WITH THAT DEFINITION FROM AN ENVIRONMENTAL ENFORCEMENT POINT OF VIEW, IS THAT IT IS TOO BROAD AND SWEEPING. IT INCLUDES SUCH FACTORS AS DIET, ALCOHOL CONSUMPTION, WORKING HABITS, AND GENERAL LIVING CONDITIONS.

BECAUSE OF THESE LIFE STYLE VARIABLES, IT BECOMES EXTREMELY DIFFICULT TO ESTABLISH CAUSAL EFFECTS BETWEEN ENVIRONMENTAL POLLUTANTS AND HUMAN HEALTH. FOR THESE REASONS, THE FOLLOWING NARROWER DEFINITION OF ENVIRONMENTAL HEALTH IS USED BY THE MINISTRY:

> "THOSE ASPECTS OF THE HEALTH OF THE GENERAL PUBLIC RELATED TO CHEMICAL, BIOLOGICAL AND PHYSICAL AGENTS PRESENT IN THE NATURAL ENVIRONMENT."

IT HAS BEEN ESTIMATED THAT THERE ARE IN THE ORDER OF 60 THOUSAND CHEMCIALS IN GENERAL USE. THERE ARE REPORTEDLY 5 MILLION ORGANIC COMPOUNDS REGISTERED IN CHEMICAL ABSTRACTS. EACH YEAR SEES APPROXIMATELY 1,000 NEW OR MODIFIED FORMULATIONS APPEAR ON THE MARKET.

THERE IS INSUFFICIENT INFORMATION AVAILABLE TO PREDICT THEIR LONG-TERM BIOLOGICAL IMPACT, EITHER SINGLY OR COLLECTIVELY, UPON MAN AND HIS ENVIRONMENT. THERE ARE INSUFFICIENT LABORATORY FACILITIES AVAILABLE IN THE WORLD TO CARRY OUT THE REQUIRED ANIMAL STUDIES, AND THE FINANCIAL RESOURCES REQUIRED TO COMPLETE SUCH STUDIES ARE ASTRONOMICAL. THERE IS A GROWING SCIENTIFIC DATA BASE ON THE GENETIC TOXICITY OF SOME OF THESE CHEMICALS. RECENTLY DAMAGE TO GENETIC MATERIAL HAS BECOME AN IMPORTANT CONCERN AND THEREFORE THE NEED TO SCREEN THIS VAST NUMBER OF CHEMICALS HAS BECOME A PRIME OBJECTIVE OF MANY JURISDICTIONS. ACCORDINGLY THE DEVELOPMENT OF TESTS WHICH PROVIDE INFORMATION ON THE MUTAGENICITY OF CHEMICALS HAS BEEN VERY TIMELY.

MUTAGENIC AGENTS

A MUTAGENIC AGENT IS DEFINED AS A SUBSTANCE THAT CAN ALTER THE GENETIC MAKEUP OF A CELL. A MUTAGENIC AGENT ACTS AT THE INDIVIDUAL CELL LEVEL. AS SHOWN IN THIS SLIDE, A MUTAGENIC AGENT CAN INDUCE GENETIC DAMAGE IN SOMATIC CELLS OR IN REPRODUCTIVE CELLS. THE DAMAGE IN SOMATIC CELLS CAN LEAD TO CELLULAR DISEASES LIKE CANCERS; THE DAMAGE IN REPRODUCTIVE CELLS CAN LEAD TO BIRTH DEFECTS. A COMMON FEATURE OF ALL THESE DISEASES IS THE INITIAL OCCURRENCE OF A MUTAGENIC EVENT. THE HUMAN EMBRYO IN ITS FORMATIVE, EARLY CELL STAGES IS MOST VULNERABLE TO THE ACTION OF THOSE CHEMICALS CAPABLE OF TRIGGERING A MUTAGENIC RESPONSE.

MUTAGENICITY TESTING OBJECTIVES

THE ACQUISITION OF KNOWLEDGE REGARDING THE IDENTITY AND HAZARDS OF MUTAGENIC AGENTS IN THE ENVIRONMENT REQUIRES A MAJOR SCIENTIFIC EFFORT. WE BELIEVE IT IS SUFFICIENTLY IMPORTANT IN TERMS OF ENVIRONMENTAL HEALTH TO JUSTIFY THE EFFORT. THE OBJECTIVES OF MUTAGENICITY TESTING ARE TWOFOLD, NAMELY TO ISOLATE AND IDENTIFY MUTAGENIC COMPOUNDS, AND TO MEASURE THE POTENCY OF THE MUTAGENIC HAZARD.

CURRENTLY THERE ARE THREE MAJOR METHODOLOGIES TO IDENTIFY MUTAGENIC OR GENOTOXIC AGENTS. THESE ARE EPIDEMIOLOGY, LONG-TERM ANIMAL STUDIES AND GENOTOXIC TESTS. THE ASSOCIATED COSTS AND TIME FRAME FOR THESE METHODS ARE SIGNIFICANTLY DIFFERENT.

METHODOLOGIES FOR IDENTIFYING GENOTOXIC AGENTS

EPIDEMIOLOGY, WHICH INVOLVES THE STUDY OF DISEASES IN HUMAN POPULATIONS, PROVIDES THE MOST RELIABLE DATA ON HUMAN HEALTH EFFECTS OF ENVIRONMENTAL CONTAMINANTS. UNFORTUNATELY, THE COSTS ARE PROHIBITIVE, RANGING UPWARDS FROM $500,000 PER STUDY. THE STUDIES CAN SPAN 10 TO 15 YEARS BEFORE AN EFFECT CAN BE IDENTIFIED IN A LARGE POPULATION. SINCE IT IS EXTREMELY DIFFICULT TO ISOLATE MUTAGENIC EFFECTS IN LARGE POPULATIONS, EPIDEMIOLOGICAL STUDIES USUALLY FOCUS ON ISOLATING THE CHEMICAL CAUSE OF SPECIFIC DISEASES, OR ON DETERMINING THE EFFECT ON A POPULATION EXPOSED TO SPECIFIC CHEMICALS.

LONG-TERM ANIMAL STUDIES ARE USED TO DETERMINE IF THERE IS A RELATIONSHIP BETWEEN A CHEMICAL AND A SPECIFIC DISEASE. ANIMALS UNDERGO ACUTE OR CHRONIC EXPOSURE OVER THEIR LIFETIME TO A SUSPECTED AGENT. AUTOPSIES ARE PERFORMED TO DETERMINE THE CAUSE OF DEATH AND THE PRESENCE OF ANY DISEASE. WHILE THESE TESTS ARE DESIGNED TO PROVIDE DIRECT EVIDENCE OF A DISEASE/AGENT ASSOCIATION, THEY ARE COSTLY (UP TO $500,000), TIME-CONSUMING (REQUIRING 2 TO 5 YEARS), AND THE WORLD TESTING CAPACITY IS LIMITED TO 100 TO 200 CHEMICALS PER YEAR. THE ADVANTAGES OF THESE LIFELONG STUDIES IS THAT THEY ESTABLISH THE CAUSE AND EFFECT OR AGENT/DISEASE ASSOCIATION.

SHORT-TERM TESTS

THE THIRD TYPE OF TESTING ARE THE SHORT-TERM GENOTOXICITY TESTS. THESE TESTS CAN BE CARRIED OUT RELATIVELY QUICKLY (FOUR TO TWELVE WEEKS) AND THE COSTS RANGE FROM $1,000 TO $3,000 PER TEST. THEY PROVIDE A RAPID MEANS OF SCREENING OUT THOSE AGENTS POSSESSING MUTAGENIC PROPERTIES. THESE TESTS ARE EFFECTIVE ANALYTICAL TOOLS

TO IDENTIFY POTENTIAL GENOTOXIC HAZARDS AND TO EVALUATE THEIR ACTION ON BIOLOGICAL SYSTEMS. A MAJOR ADVANTAGE OF SHORT-TERM TESTS IS THEIR APPLICABILITY TO A WIDE VARIETY OF SAMPLE TYPES. THEY HAVE BEEN USED ON THE FOLLOWING TYPE OF SAMPLES.

1. PURE CHEMICALS
2. INDUSTRIAL EFFLUENTS AND EMISSIONS
3. WATERS - SURFACE/GROUND/DRINKING
4. LANDFILL LEACHATES.

A CLOSE-KNIT DEVELOPMENTAL APPROACH INVOLVING OUR EXPERTISE IN BIOLOGICAL TESTING AND CHEMICAL TECHNIQUES IS NEEDED TO EXPAND THEIR USE ON ENVIRONMENTAL SAMPLES.

TO GENERATE A SOUND, WELL-VALIDATED DATA BASE FOR ENVIRONMENTAL MATRICES, THE FOLLOWING ANALYTICAL FUNCTIONS NEED TO BE ADDRESSED:

1. DEVELOP MUTAGENICITY TESTS
2. DEVELOP CONCENTRATION SYSTEMS
3. ASSESS PERFORMANCE OF TEST SYSTEMS
4. TEST ENVIRONMENTAL SAMPLES
5. INTERPRET TEST RESULTS.

THE MINISTRY OF THE ENVIRONMENT BIOHAZARDS LAB HAS BROGHT ON-LINE FIVE TEST SYSTEMS TO CONFORM TO THE TEST BATTERY APPROACH FOR VALIDATING DATA. THE SALMONELLA POINT MUTATION ASSAYS (AMES TEST), THE E. COLI DNA REPAIR ASSAY (ROSENKRANZ TEST), THE CHINESE HAMSTER OVARY SISTER CHROMATID EXCHANGE ASSAY, THE MOUSE BONE MARROW MICRONUCLEUS ASSAY AND THE MOUSE ABNORMAL SPERMHEAD MORPHOLOGY ASSAY ARE NOW ON-LINE.

MOST SHORT-TERM TESTS FOLLOW THE SAME BASIC PROCESS. THE SAMPLE EXTRACT IS APPLIED AT VARYING CONCENTRATIONS TO THE TEST SYSTEM OR ORGANISM. THE SUBSTANCE UNDER TEST IS TESTED DIRECTLY OR METABOLICALLY ACTIVATED BY THE ADDITION OF A SPECIAL ENZYME. AFTER THE ELAPSE OF A DEFINED AMOUNT OF TIME, THE SYSTEM IS EXAMINED FOR SIGNS OF GENOTOXICITY. THE FOLLOWING BRIEF DESCRIPTION OF THE AMES TEST IS ILLUSTRATIVE OF THE RELATIVE SIMPLICTY AND ELEGANCE OF THESE TEST SYSTEMS.

AMES TEST

THE AMES TEST, DEVELOPED BY DR. BRUCE AMES IN THE LATE SIXTIES, IS THE BEST KNOWN AND MOST WIDELY USED OF SHORT-TERM TESTS. THIS SLIDE ILLUSTRATES AN AMES TEST PLATE SHOWING A POSITIVE RESULT INDUCED BY A MUTAGENIC AGENT. THE PROLIFERATION OF COLONIES SURROUNDING THE APPLIED CHEMICAL IS INDICATIVE OF A MUTAGENIC RESPONSE. THE AMES TEST'S POPULARITY IS DUE TO THE FACT THAT IT IS RELATIVELY RAPID AND INEXPENSIVE, THERE EXISTS AN EXTENSIVE DATA BASE ON THE ASSAY AND GOOD CORRELATION HAS BEEN ACHIEVED BETWEEN KNOWN CANCER CAUSING AGENTS AND THE FREQUENCY BY WHICH THEY ARE DETECTED AS MUTAGENS BY THIS ASSAY. THE AMES TEST OPERATES ON THE FOLLOWING PRINCIPLE: A SPECIAL LINE OF SALMONELLA BACTERIA HAVE BEEN ENGINEERED SO THAT THEY NOW LACK THE ABILITY TO MAKE HISTIDINE, AN AMINO ACID ESSENTIAL FOR GROWTH. THE SPECIALLY MUTATED SALMONELLA CELLS ARE PLACED IN A MEDIA WHICH CONTAINS THE SAMPLE BEING TESTED. IF THE SAMPLE IS NON-MUTAGENIC, NOTHING WILL HAPPEN TO THE CELLS AND THEY WILL NOT GROW. IF THE SAMPLE HAS MUTAGENIC PROPERTIES, IT WILL REMUTATE THE CELLS AND ENABLE THEM TO MANUFACTURE HISTIDINE, WHICH IN TURN TRIGGERS CELL GROWTH. THE PROLIFERATION OF COLONIES ON THE PLATE IS INDICATIVE OF THE PRESENCE OF A MUTAGEN.

METABOLIC ENZYMES ARE ADDED TO THE TEST MIXTURES BECAUSE MOST KNOWN MUTAGENS AND CARCINOGENS REQUIRE SOME CHANGE IN THEIR CHEMICAL STRUCTURE BEFORE THEY

BECOME AN ACTIVE MUTAGEN OR CARCINOGEN. ENZYMES CAPABLE OF MAKING THESE STRUCTURAL CHANGES ARE PRESENT IN HIGHER FORMS OF LIFE BUT NOT IN SALMONELLA, AND CONSEQUENTLY THEY SHOULD BE ADDED TO THE REACTION MIXTURE.

SAMPLE CONCENTRATION AND EXTRACTION

TO PROPERLY CARRY OUT MUTAGENICITY TESTING, IT IS ESSENTIAL THAT STRONG FRONT END CHEMISTRY SUPPORT BE AVAILABLE. GREAT CARE MUST BE EXERCISED IN DECIDING UPON SAMPLE CONCENTRATION TECHNIQUES, AND THE METHODS EMPLOYED TO EXTRACT THE VARIOUS SAMPLE ALIQUOTS. FOR EXAMPLE, CHANGING THE SOLVENTS USED IN EXTRACTING SAMPLES CAN RESULT IN FALSE POSITIVES BEING OBTAINED. INSUFFICIENT CARE IN EXTRACTING AND SEPARATING THE VARIOUS SAMPLE FRACTIONS CAN RESULT IN SUBSEQUENT TOXIC SHOCK TO THE BACTERIA, RESULTING IN ANOMALOUS DATA. CONSEQUENTLY IT IS ESSENTIAL TO HAVE A WELL-DEFINED PROVEN SAMPLE CONCENTRATION AND CHEMICAL EXTRACTION PROCEDURES IN PLACE BEFORE UNDERTAKING SHORT-TERM TESTS.

DATA CONFIRMATION

POSITIVE AMES TESTS PROVIDE AN INDICATION OF A POTENTIAL GENOTOXIC HAZARD. TO CORROBORATE THE AMES TEST RESULT, A "CORE BATTERY" OF SHORT-TERM TESTS SHOULD IDEALLY BE PERFORMED. THE MINIMUM NUMBER OF TESTS SUGGESTED RANGES FROM THREE TO FIVE. THERE ARE CURRENTLY OVER 40 SHORT-TERM TESTS TO CHOOSE FROM. THE BATTERY OF TESTS NORMALLY HAVE DIFFERENT MUTAGENIC END POINTS WHICH SIGNIFY A MUTAGENIC EVENT HAS OCCURRED. THEY VARY IN THE TYPE OF ORGANISM IMPACTED UPON, FOR EXAMPLE, YEAST CELLS OR MAMMALIAN CELLS.

THE DEGREE OF AGREEMENT BETWEEN THE VARIOUS MUTAGENICITY RESULTS OBTAINED WITH DIFFERENT TEST SYSTEMS IS CONSIDERED THE BEST MEASUREMENT OF A TEST'S ACCURACY. FURTHERMORE, WHEN ONE TRIES TO EXTRAPOLATE THE FINDINGS IN TERMS OF DEGREE OF HAZARD TO MAN, GREATER CONFIDENCE CAN BE PLACED ON DATA VALIDATED BY SEVERAL TEST SYSTEMS.

THE SHORT-TERM TESTS CAN GIVE FALSE POSITIVE OR FALSE NEGATIVE RESULTS. NORMALLY THESE ERRORS WILL BE CAUGHT DURING FOLLOW-UP REPEAT TESTING OR BY NON-CONFIRMATION WITH OTHER TEST SYSTEMS. THIS IS ONE OF THE REASONS WHY DATA BASED ON RANDOM TESTS USING A SINGLE TEST SYSTEM ARE NOT RELIABLE.

DATA ACCEPTABILITY

IN THE AMES TEST, FOR EXAMPLE, THREE CRITERIA ARE NORMALLY APPLIED TO DATA SETS TO ENSURE THE INTEGRITY OF THE RESULTS. THE FIRST IS A DEMONSTRATED DOSE-RESPONSE RELATIONSHIP, IN WHICH INCREASING CONCENTRATIONS OF THE UNKNOWN COMPOUND SHOWS A PROPORTIONAL INCREASE IN MUTATIONS OF BACTERIAL CELLS.

THE SECOND CRITERIA REQUIRES THAT THE NUMBER OF CELLS WHICH GROW ON THE PLATE BE APPROXIMATELY TWICE THE BACKGROUND LEVEL. THE THIRD CRITERIA IS THAT THE TEST RESULT CAN BE REPRODUCED WHEN THE SAMPLE IS RETESTED.

THE SLIDE SHOWS THE CHACTERISTICS OF A MUTAGENIC RESPONSE. AS THE CONCENTRATION OF SAMPLE IS INCREASED, A PROPORTIONATE INCREASE OF MUTANT CELLS IS OBSERVED. MOREOVER, THE NUMBERS OF MUTANTS INDUCED BY THE SAMPLE ARE SIGNIFICANTLY HIGHER THAN BACKGROUND. THIS SLIDE ALSO SHOWS THE EFFECT OF ACTIVATION ENZYMES ON THE MUTAGENIC RESPONSE. THE ACTIVITY OF THE SAMPLE IS INCREASED IN THE PRESENCE OF S9, THE ENZYMES. THIS RESPONSE PATTERN IS TYPICAL OF PROMUTAGENIC AGENTS.

DATA INTERPRETATION

IN EARLIER STUDIES, DR. BRUCE AMES AND CO-WORKERS ESTABLISHED THAT 85 - 90% OF KNOWN ANIMAL CARCINOGENS WERE MUTAGENIC WHEN SUBJECTED TO THE AMES TEST. A SUBSEQUENT STUDY CARRIED OUT AT TORONTO'S PRINCESS MARGARET HOSPITAL REPORTED A 60% POSITIVE ASSOCIATION FOR THE SUBSTANCES TESTED. THE LOWER PERCENTAGE WAS PARTLY ATTRIBUTED TO THE FACT THAT THE CHEMICALS CHOSEN FOR THE STUDY WERE KNOWN TO

BE LESS SENSITIVE TO THE AMES ASSAY. ASSUMING THEN THAT THE CORRELATION RANGES FROM 60 - 90%, IT CAN BE CONCLUDED THAT THE AMES TEST PROVIDES A RELATIVELY FAST AND INEXPENSIVE INDICATION OF THE DEGREE OF GENOTOXIC HAZARD ASSOCIATED WITH SPECIFIC CHEMICALS.

RELATIVE RISK INDEX

THE RELATIVE WEIGHT OF THESE TESTS IN PREDICTING A GENOTOXIC HAZARD IS SUMMARIZED ON THIS SLIDE. LONG-TERM ANIMAL STUDIES AND EPIDEMIOLOGICAL DATA ARE THE BEST SOURCES OF INFORMATION ON THE GENOTOXIC EFFECTS OF A CHEMICAL. HOWEVER, BECAUSE OF THE LIMITATIONS OF THESE TESTS, THERE IS RELATIVELY LITTLE SUPPORTING DATA AVAILABLE FROM THESE SOURCES. SHORT-TERM MUTAGENICITY TESTS ARE BUT THE FIRST PHASE OF A HIERARCHICAL TEST SYSTEM DESIGNED TO ASSESS IF A SUBSTANCE POSES A GENOTOXIC HAZARD TO MAN. THEY ARE THE MOST COST-EFFECTIVE MEANS OF OBTAINING INFORMATION ON A LARGE NUMBER OF SAMPLE SOURCES.

IN THE INTERIM, IT WOULD APPEAR THAT SHORT-TERM MUTAGENICITY TESTING WILL BE USED PRIMARILY AS AN INDICATOR TEST SYSTEM IN ENVIRONMENTAL MONITORING PROGRAMS. PARTICULARLY, IN DEALING WITH COMPLEX ENVIRONMENTAL SAMPLES, THE TEST CAN BE USED TO FLAG FOR THE PRESENCE OF A POTENTIAL HAZARD, AND TO INDICATE WHAT SPECIFIC FRACTION OF THE COMPLEX MIXTURE CONTAINS MUTAGENS.

HAZARD ASSESSMENT/STANDARD SETTING

THERE IS AN ALTERNATIVE AND MORE PRACTICAL APPROACH TOWARDS INCORPORATING MUTAGENICITY FINDINGS IN REGULATORY REQUIREMENTS. GUIDELINES COULD BE DEVELOPED BASED ON OBSERVED GENETIC DAMAGE TO RESIDENT ENVIRONMENTAL SPECIES. THE GUIDELINES CAN USE DATA FROM SHORT-TERM TESTS APPLIED TO PLANTS, ANIMALS OR FISH EXPOSED TO ENVIRONMENTAL LEVELS OF THE SUSPECTED HAZARDOUS AGENTS. DETECTION OF MEASURABLE DAMAGE IN SUCH IN SITU SYSTEMS WOULD INDICATE THE PRESENCE OF A

GENOTOXIC HAZARD. THERE HAVE BEEN A NUMBER OF STUDIES CARRIED OUT SHOWING THAT THIS IS A WORKABLE METHOD FOR GAUGING THE IMPACT OF ENVIRONMENTAL GENOTOXIC HAZARDS ON SELECTED TARGET SPECIES.

RESEARCH AND DEVELOPMENT

THE MINISTRY IS CONDUCTING A TWO PRONGED EFFORT TO EXPAND THE INFORMATION BASE UPON WHICH RATIONAL STANDARD SETTING AND REGULATORY DECISIONS CAN BE MADE.

THE IN-HOUSE EFFORTS HAVE BEEN DIRECTED TO THE PROVISION OF A LAB FACILITY THAT MEETS THE SAFETY REQUIREMENTS FOR HANDLING MUTAGENIC CHEMICALS. A NEWLY CONSTRUCTED BIOHAZARDS LAB COSTING $450,000 WAS RECENTLY BROUGHT ON-LINE. THIS FACILITY IS DESIGNED TO ISOLATE, CONTAIN AND REMOVE ANY MUTAGENIC MATERIAL FROM THE LAB'S AIR OR WASTES, TO PROVIDE A SAFE WORK PLACE FOR ALL LABORATORY STAFF, AND TO PREVENT THE DISCHARGE OF HAZARDOUS MATERIALS TO THE ATMOSPHERE. SCIENTISTS ARE USING A NUMBER OF SHORT-TERM TESTS FOR SPECIFIC ENVIRONMENTAL STUDIES, AND ARE SIMULTANEOUSLY CARRYING OUT DEVELOPMENT WORK ON NEW TESTS AND THE REFINEMENT OF EXISTING TESTS. THE INTENTION IS TO DEVELOP AND MAINTAIN ON-LINE, A WELL PROVEN BATTERY OF SHORT-TERM TESTS TO SUPPORT THE MINISTRY MONITORING PROGRAMS.

THE OTHER THRUST OF THE MINISTRY PROGRAM IS TO FUND RESEARCH IN UNIVERSITIES WITH A DEMONSTRATED CAPABILITY IN THIS AREA. TO DATE OVER 580 THOUSAND DOLLARS HAS BEEN ALLOCATED TO THIS RESEARCH AREA.

THE PROJECTS UNDERWAY ARE THE FOLLOWING:

1. ENVIRONMENTAL MUTAGENS, PROMOTERS AND INHIBITORS

   THE KEY ELEMENTS OF THIS YORK UNIVERSITY STUDY ARE THE EFFECTS OF PROMOTERS AND INHIBITORS ON THE ACTION OF MUTAGENS AND THE RESPONSE OF MUTAGENIC SUBSTANCES IN COMBINATION.

2. World Health Organization Interlaboratory Comparison

This study, conducted by MOE and York University scientists, is to evaluate the short-term tests mentioned here in order to have validation and international approval and acceptance of these tests.

3. Fish Mutagenicity Assay

This University of Guelph study is developing and evaluating a fish assay, specifically the fish embryo, as an in situ system for the detection of genotoxic activity in the field.

4. Mouse In Situ Study

The study, at the University of Windsor, is to evaluate the Sister Chromatid Exchange assay on mice as an in situ test for monitoring environmental mutagens in the atmosphere.

5. Literature Retrieval Methods

A computerized literature search is underway at York University to establish a library of references on mutagenic compounds in the environment.

As can be seen from the foregoing, the MOE is developing a strong internal and external scientific capability allied to an extensive data base. This will auger well for any future decisions which have to be made, to detect and measure genotoxic hazards and to assess their impact upon the environment.

To recapitulate, the Environment Ministry's broad mandate is to protect both the natural environment and by extension, its crowning glory, man.

MUTAGENICITY TESTING IS YET ANOTHER SCIENTIFIC TOOL WHICH CAN PROVIDE EARLY WARNING OF POTENTIAL ENVIRONMENTAL HAZARDS. SHORT-TERM MUTAGENICITY TESTS PROVIDE RELATIVELY FAST, INEXPENSIVE METHODS FOR GAUGING GENOTOXIC HAZARDS. GREAT CARE MUST BE EXERCISED, HOWEVER, IN INTERPRETING THE DATA, AND IN ENSURING THAT THE DATA BASE CAN WITHSTAND RIGOROUS SCRUTINY. THE MINISTRY HAS A COMPREHENSIVE PROGRAM IN PLACE, COMBINING INTERNAL CAPABILITIES AND EXTERNAL RESEARCH, TO ENSURE THE BEST POSSIBLE INTERPRETATION AND USE OF MUTAGENICITY STUDY FINDINGS.

DIOXIN CONTAMINATION AND HEALTH ISSUES

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For more than ten years the word dioxin, associated as it is with Vietnam and Seveso, has captivated the attention of the media. How often have we heard it anathematized as "the most toxic chemical made by man"? In fact what is usually being referred to is a particular member, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) of the polychlorinated dibenzo-p-dioxins (PCDDs), a class of organo-chlorine chemicals comprising 75 congeners. There are 22 TCDD isomers alone! Imprecision in the definition of the chemical can have unfortunate and indeed alarming consequences for there are marked differences in toxicity between the dioxin congeners. To further complicate matters the chemically-related polychlorinated dibenzofurans (PCDFs) are often associated with the PCDDs as industrial contaminants.

The issues to be discussed with the general class of dioxins are their sources; their pathways and transport; their occurrence in

the environment and in food; their toxicological effects, and their risk assessment for human health. The physical and chemical characteristics of the dioxins determine not only their environmental problems but also the factors that give them international dimensions. They are:

1) relatively insoluble in water, but soluble in lipids;
2) easily absorbed onto soil;
3) environmentally stable: the half-life of 2,3,7,8-TCDD in soil could be up to 10 years;
4) metabolized slowly: this isomer's biological half-life in mammals is 20-40 days.

After release into the environment, they may be transformed and transported in many ways: they may be transported by currents of air and water or in association with solid particles; they may be concentrated, or diluted by a number of physical or biochemical processes. Human and environmental exposure therefore takes place not only at the point of use or at discharge, but also at points distant both in space and time. These factors place dioxins and their transboundary movement in a niche of special international concern.

SOURCES

All dioxins are by-products of industrial processes or natural combustion: none are sold for commercial use. The major industrial sources of PCDDs are the chlorophenols and their derivatives of which the best known are 2,4-D; 2,4,5-T, and hexachlorophene (1). Pentachlorophenols in Canada can contain up to 650 ppm of octachlorodibenzo-p-dioxin and 0.02 ppm of TCDD (2). The real problem is that the massive production of these compounds has resulted in large quantities

of industrial chemical waste now widely dispersed in landfill sites, particularly in the United States, of which the Love Canal is the most notorious. Furans, as contaminants of commercial PCBs, are likely to be present in transformers and other PCB-containing equipment. They are also formed in significant quantities when PCBs have been accidentally incinerated, e.g., in transformer fires as in Binghamton, New York State, although the uses of PCBs are being systematically phased out.

Combustion of municipal wastes that contain a high percentage of chlorinated organics, combustion of chlorophenol treated wood and chemical wastes, and other incineration processes are known to produce dioxins and furans under specific conditions. The explanation of the chemical reactions during combustion that produce trace concentrations of PCDDs was developed by scientists at Dow Chemical Co. and is known as the "trace chemistries of fire" hypothesis (3). Analyses to date are not unequivocal but do indicate the presence of dioxins including the 2,3,7,8-TCDD isomers, as well as PCDFs and PCBs in fly ash and flue gases from a number of sources (4). The emission rates of dioxins from incineration are highly variable, depending on fuel type and combustion methodology. It has been shown that the formation of chlorinated organics are favoured by high fuel-chlorine content, low temperatures, inefficient mixing and especially by the presence of contaminants or precursors in the fuel source. PCBs are also known percursors to PCDFs. Inefficient combustion of municipal solid wastes in small incinerator units with inadequate emission control is the major source of such pollutants in the atmosphere. The data indicate that emissions of chlorinated dioxins and chlorinated dibenzofurans are "general phenomena related to all combustion processes" (5).

PATHWAYS AND TRANSPORT

The long range aerial transport of traces of chemicals has been recognized for many years. There is evidence for example, that DDT has travelled great distances from its origin of application to the remote regions of Antarctica and sulphur oxides deposited in Sweden and Norway have been found to originate as far away as the United Kingdom and France. The prevailing pattern of air movement on this continent would suggest that if the long range transport of dioxins does occur Canada will be the recipient of pollution from the North-Eastern United States, particularly the Ohio Valley. One of the most difficult questions concerns the total amount of PCDDs which enter the environment annually. The Canadian estimate for PCDD emissions from municipal incinerators is very roughly estimated at about 13.4 kg/yr (2).

The total gross estimate of polychlorinated dibenzo-dioxins released into the Canadian environment is 1.5 tonnes per annum (2); of which the major source is pentachlorophenol. The homologue breakdown would be nearly three quarters octachlorodibenzo-p-dioxin and less than 0.3 per cent TCDDs. However, it should be pointed out that not the total weight but the degree of availability and concentration by isomer in various matrices jointly pose the risk. The total estimate of dioxins indicates a potential threat only, since most of the dioxins are probably bound in landfill sites or may have biodegraded or transformed. Contamination of water bodies by dioxins can occur following the spraying of chlorophenoxy herbicides on forests. Possible routes of water contamination from spraying are direct application, drift of the spray and overland transport after heavy rains. The transport of dioxin-contaminated soil into lakes or streams by erosion constitutes

another route of contamination. These findings are consistent with recent reports that TCDDs can migrate to nearby water bodies from industrial chlorophenol wastes, buried or stored in various landfills. The most renowned examples being the New York State Hyde Park and Love Canal dump sites. Canadian estimates, filed in the U.S. District Court in 1981, of the total dioxin content of the Love Canal site were 2 000 kg TCDD. It was postulated in the same submission that high dioxin levels in the Lake Ontario ecosystem in the early 1970's represented only 0.1 per cent to 1 per cent (2-20 kg) of the buried dioxins.

Water contamination can inevitably cross national boundaries and international focus was given to this problem in 1980 by the reported presence of 2,3,7,8-TCDD in Lake Ontario herring gull eggs (6). Retrospective analysis showed that a decrease of TCDD levels has occurred since 1971. This has led to the development of an ecological objective by Great Lakes Science Advisory Board of the International Joint Commission, namely that 2,3,7,8-TCDD should be absent from all compartments of the ecosystem, including air, land, water, sediment, and biota where absent means not detectable by the best available technology (at present 0.01 µg /kg in tissue and sediment, and 0.00001 µg/L in water).

OCCURRENCE

Food consumption is most likely to be the greatest contributor to the exposure of the general public to dioxins and furans. Animals are able to accumulate these contaminants in adipose tissue to levels that greatly exceed ambient concentrations.

In late 1978, the Environmental Protection Agency of the United States reported preliminary observations (7) on the presence of 2,3,7,8-TCDD in several species of fish originating from rivers which

flowed into Lake Huron. Details of this survey published recently revealed that 26 of 36 samples comprising six different species of fish were positive for 2,3,7,8-TCDD (8). In early 1979 the New York State Department of Health found measureable levels of this isomer in fish from Lake Ontario (9). Subsequent refinements in the analytical techniques by workers in the Health Protection Branch and elsewhere have shown that 2,3,7,8-TCDD can be measured with confidence in fish at the ppt levels (10). Comprehensive dioxin analyses of Great Lakes fish by Canadian and U.S. scientists have shown that traces of 2,3,7,8-TCDD are confined mainly to Lake Ontario fish with the highest levels for commercial fish in carp, catfish, and eels; the highest levels were over 30 ppt (11).

Hexa-, hepta- and octa- chlorodibenzodioxins and octachlorodibenzofuran have been detected in livers of chickens, raised on wood chips that contained contaminated pentachlorophenol (12). The much publicized chick edema factor (13) which resulted in the death of many birds in the U.S.A. was due to dioxin contamination of fats used as chicken feed. Clearly contamination of animal tissues through chlorophenols could lead, ultimately, to the presence of dioxins in foods.

There have been no reports to date of dioxins in Canadian drinking water, the current limit of detection being the miniscule 1 ppt, but the possibility of their occurrence exists - particularly with ever-increasing sensitivity of the analytical methods.

TOXICOLOGY

Our knowledge of the toxicity of the dioxins comes from both human exposure and animal experimentation (2). For the former,

workplace exposure has usually been to mixtures of PCDDs and chlorophenols so that clear symptomology has not been possible although dermal lesions, e.g. chloracne, and neurological abnormalities are usually reported. The toxicity of 2,3,7,8-TCDD has been extensively studied in many species - mammalian, avian, and reptilian - and it is known to be acutely toxic to mammals, and a confirmed carcinogen and teratogen, causing reproductive anomalies and affecting a wide range of physiological processes. Although this isomer is highly toxic, there is a wide range in sensitivity depending on species, sex, and route of administration: for example, there can be as much as a 10 000 fold difference in oral LD_{50} between the guinea pig and hamster (14). It seems unlikely that 2,3,7,8-TCDD, or other PCDDs tested, are capable of producing mutations or chromosomal aberrations (2) - this has implications for the assessment of risk.

The toxicities of the other congeners are less well characterized although it is clear that isomers of the same dibenzo-p-dioxin exhibit markedly different toxicity, hence making their individual unequivocal identification vital. It is known that the 2, 7 dichloro-, and the octachloro-dibenzodioxins have low acute toxicities; while hexachloro-dibenzodioxins with chlorines in the 2,3,7,8-positions and 2,3,7.8-tetrachloro-dibenzodioxin are very toxic (15): the acute toxicity of 2,3,7,8-TCDD in fact is up to 3 000 times higher than the di- or the octachlorinated isomer. The toxicity of the individual dioxin is dependent on its structure, particularly on the location of chlorine atoms in the 2,3,7 and 8 positions (16).

RISK ASSESSMENT

Risk is the product of hazard and the probability of its occurrence. The latter, in turn, depends on both exposure to the dioxins and the susceptibility of the host (17). Hazard clearly depends on which congener is described: in fact, all estimates have been confined to the most toxic 2,3,7,8-TCDD. Susceptibility is concerned with such defence mechanisms as repair, immunological surveillance, metabolic detoxication but the import of these effects for this isomer are not clear.

The three major routes of exposure to human populations are oral, dermal, and respiratory: the former being of prime significance to the general population and the others to those occupationally exposed. In the workplace, the greatest exposure would be to those working in the manufacture or formulation of chlorophenols or pesticides containing PCDDs. Second line exposure would by those using these products directly, for example, during pest control spraying operations, at wood treatment or textile facilities, tanneries, or pulp and paper mills. The tertiary exposure groups could be by workers handling contaminated products such as sawmill workers, lumber suppliers and seamstresses. It should be noted that in Canada, controls have been established, through an interim standard of the Pest Control Products Act, of a maximum concentration of 0.1 ppm of TCDD in 2,4,5-T and Silvex. For other products, decisions are made on a case-by-case basis with the objective of reducing contamination to the lowest practical level. Thus for 2,4-D products, that can contain isomers of mono-, di-, tri-, and tetrachlorodioxins, the Department of Agriculture (18) has declared that at present 2,4-D must contain less than 10 ppb of a specific dioxin isomer. We have no guidelines at present for pentachlorophenol.

Exposure of the general public is likely to be less than that of the workplace groups but the identification of dioxins in fish, poultry and, in other countries, in milk, pork and beef, indicates that diet can be a source of PCDD exposure. Restrictions of uses of chlorophenols containing PCDDs on farms and near animals and restrictions on the PCDD content of 2,4-D greatly reduce the risk of exposure to agricultural products. Combustion can release dioxins although at the present time there are insufficient data available on their inhalation toxicity to estimate the risk to the public from this source.

Considering the major source of dietary exposure by the public, namely via fish from the Great Lakes, the risk will be influenced by the amount eaten. Canadians consume about 13 lbs of fish/person/year or about 16 g/person/day: by comparison U.S. estimates of fish consumption vary up to twice the Canadian estimates. In 1981, the Minister of National Health and Welfare announced the establishment of a guideline of 20 ppt of 2,3,7,8-TCDD in commercial fish as part of the federal program to control health hazards from environmental contaminants (19). These estimates were based on extensive rodent studies (20). If the level of dioxin in fish is 20 ppt, then the safety margin for a Canadian ingesting 16 g of fish daily is over 2 000, based on rat reproductive studies. In other words, these dioxin concentrations represent 2 000 times lower levels than those which would elicit the first measureable "effect level" in rat reproductive studies. The safety margin for carcinogenicity is of the same order of magnitude: 2 000 for 20 ppt dioxin in fish. The application of a safety factor for carcinogenicity can be justified because there is no evidence that 2,3,7,8-TCDD reacts with DNA as a mutagen, or genotoxic carcinogen, rather it acts via enzyme induction. If a different approach is taken based on the no-observed-effect level for carcinogenicity in rodents at 1 ng 2.3.7.8-TCDD/kg body weight per day in lifetime studies (20). The safety factor

is now reduced to 200. You will see how important the knowledge of the mechanism of action is for the risk assessment process.

Thus, an administrative guideline has been established for 2,3,7,8-TCDD in fish. More stringent regulations have been established under the Food and Drugs Act and Regulations. As early as 1964, food products could not be sold if they contained "fatty acids and their salts containing chick-edema factor or other toxic factors". Similarly, from 1980, foods cannot be sold if they contain chlorinated dibenzo-p-dioxins. The key to implementation is of course the concentration of dioxin as detected by a recognized method of analysis.

Risk extrapolations using the linearized multi-stage model have also been carried out by the Carcinogen Assessment Group of the U.S. Environmental Protection Agency (21). This procedure is based on the presumption of no threshold in the dose response curve and is designed to provide an upper limit on the actual risk through the further assumption of low-dose linearity. Using data on liver, lung, hard palate and nasal tumours observed in female rats, converting the results to humans on a surface area basis, and taking the oral and inhalation exposure routes to be effectively comparable, a continuous exposure of one picogram of TCDD per cubic meter of air was estimated to induce a lifetime risk of about 9×10^{-5}. Using similar methods, Crump (22) recently estimated the carcinogenic risk associated with the spraying of 2,4,5-T contaminated with dioxin in Nova Scotia forests to be many orders of magnitude lower. The Province of Ontario has developed as an interim guideline for ambient air, 30 pg 2,3,7,8-TCDD/m^3 not to be exceeded on the average over a year.

In order to obtain an independent assessment of the data on dioxins and to make recommendations on the potential for harm to human health and the environment an Expert Advisory Committee was established

by the Minister of National Health and Welfare and the Minister of the Environment. This action was undertaken under the authority of the Environmental Contaminants Act and was triggered by the finding of 2,3,7,8-TCDD in fish and wildlife samples from the Great Lakes Region.

The Committee's nine members were drawn from industry, government, and academia and were selected for their expert knowledge on various aspects of dioxins. The committee, which was convened in November 1981, was charged with addressing the following:

(a) The sources of chlorinated dioxins (including formation of combustion by-products);

(b) the pathways by which dioxins enter the environment;

(c) the means by which dioxins are transported within the environmental media;

(d) the conditions under which the dioxins persist or are destroyed in the environment;

(e) the potential or actual exposure of both human and non-human targets to dioxin;

(f) the toxicity of the various chlorinated dioxins;

(g) the risks to human and non-human targets from 2,3,7,8-TCDD; and

(h) the risks related to other chlorinated dioxins.

The committee has completed its meetings and the report is expected to be issued this summer.

CONCLUSION

This is, in brief, the current status in Canada of the PCDDs with respect to their occurrence and health significance. Undoubtedly, we need more monitoring data in a range of media, more knowledge of the toxicology of all those PCDDs that we are exposed to, parti-

cularly with respect to inhalation toxicology; more information on predioxins and dioxin metabolism in tissues and organs. All this will take time and resources in spite of the great international interest and activity on this question. Meanwhile, we should be prudent in restricting exposure to the PCDDs - whether public or occupational. We also should resist the temptation to claim health effects in regions that are often almost "trans-scientific", to use the terminology of Weinberg (22), i.e. beyond the limits of the scientific method. Our powerful analytical tools can determine concentrations of these chemicals at levels where we must exercise our caution in extrapolation of the biological effects for we are in the realm where what can be stated in the language of science - cannot necessarily be answered by science.

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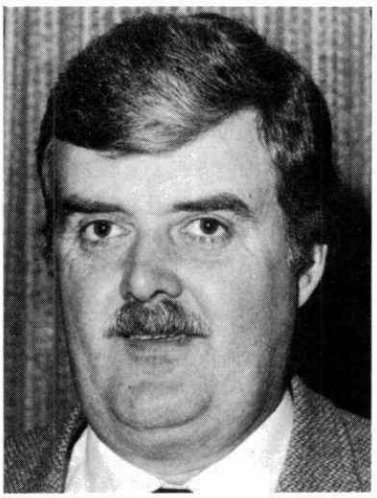
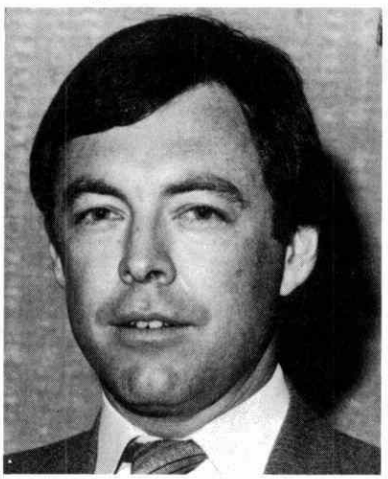
SESSION IV – WASTEWATER TREATMENT



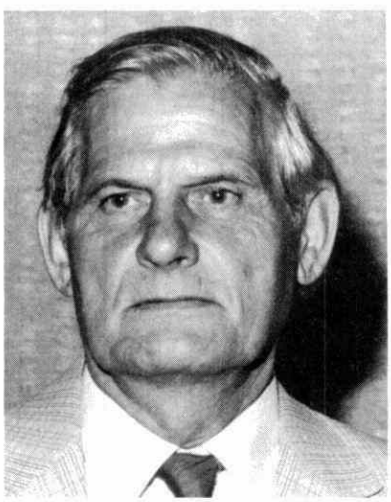
Chairman: W.J. Gibson
Regional Director
Northeastern Region
Ontario Ministry of the Environment
Sudbury, Ontario

K.M. MacAuley, John Labatt Ltd.
London, Ontario

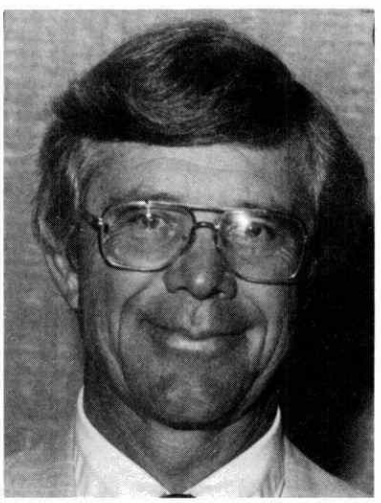


A.L. Atkinson, Vice-President
Marshall Macklin Monaghan Ltd.,
Toronto, Ontario

E.R. Fioroni, Biological
Oxidation Manager,
Polysar Limited,
Sarnia, Ontario



Dr. C.D. Logan, Director of Research,
Ontario Paper Company,
Thorold, Ontario



Dr. J. McGrew, President,
Applied Science and Engineering, Inc.,
Englewood, Colorado

THE TREATMENT OF STARCH BASED EFFLUENT BY AN ANAEROBIC/AEROBIC PROCESS

by
K.M. MacAULEY, P. ENG.
PROJECT MANAGER
JOHN LABATT LIMITED

DR. T.S. WALKER
SENIOR SCIENTIST
JOHN LABATT LIMITED

1. INTRODUCTION

Industrial Grain Products, an operating unit of the Grains Processing Group of John Labatt Limited is Canada's only producer and one of the world's largest producers of wheat starch and gluten products. Approximately 45 starch products and 6 gluten products are produced to meet the varied customer/industry requirements.

Starch products are sold primarily in Canada and are used in a variety of industrial and food-based applications.

Gluten, on the other hand, is sold predominantly on the export market with major competitors located primarily in Australia, the United States, and Europe. Gluten is noted for its uniquely functional protein and is used in baking, pet food, cereals, milling, processed meats, and other food applications.

IGP operates two manufacturing facilities; one in Candiac, Quebec and the other in Thunder Bay, Ontario. The latter plant which has housed grain-related activities since 1906, and IGP since the 1940's is the focus of the discussion to follow.

2. PROCESS

The manufacture of wheat starch and gluten involves mixing wheat flour with water to form a dough, which is irrigated in perforated troughs; allowing the starch to drain away, leaving the gluten behind as a rubbery mass.
The starch is cleaned, refined, and concentrated by a series of screens and centrifuges. The excess water, which contains the majority of the soluble portion of the flour, is discharged as effluent. The starch and gluten are dried and sold as powdered products.

The typical characteristics of IGP's process effluent are shown on Figure 1.

3. BACKGROUND

In 1967, IGP was served with an order, by the then Ontario Water Resources Commission, which required a programme for the reduction of the BOD_5 levels discharged to the river. Investigations at that time failed to find any available practical technology or experience in the treatment of effluent with IGP's characteristics. Initial efforts to reduce the solubles loss focused on production process modifications. These included, at a capital cost in excess of $2.5 million, the evaporation and drying of the solubles streams. Toward the end of the 1970's the operating costs of these unit processes became unacceptable. At the same time, the BOD_5 loading of the effluent remained unacceptably high.

Several in-depth studies were carried out on the treatability of the plant effluent using resources such as McGill University, consultants, and internal staff. These efforts and those of the industry elsewhere in the world had developed no practical cost effective system by the time the MOE served IGP with

the current Control Order in June 1979. The Order required a reduction of the BOD_5 discharge from the plant to a maximum 900 kilograms per day.

4. SITE CONSTRAINTS

The selection of an appropriate waste treatment technology was significantly impacted by the characteristics of both the IGP site and the local infrastructure.

The following slides illustrate the lack of land available for siting any waste treatment facility. IGP is bounded on one side by the Kaministiquia River and on the other by the CPR transcontinental mainline. In addition, the facilities for sludge disposal in the Thunder Bay area were and continue to be extremely limited.

5. ALTERNATIVES

Consultants were retained to run a series of aerobic bench scale tests in the plant. The conclusion of the three-month study was that a single-stage activated sludge system with equalization, primary treatment, and a thickener could conceivably be used. However, the estimated site preparation, capital and operating costs were extremely high and sludge disposal would continue to be a major problem.

At this point, IGP started to look seriously into anaerobic systems which were becoming established in Europe for the treatment of high strength wastes, primarily from the beet sugar industry. From the potential suppliers, our choice narrowed to two; C.S.M. of Holland with their "Biothane" process and Sorigona of Sweden with their "Anamet" process. In both cases, the technology and practical development hadbeen done "in-house" in connection with the treatment of the soluble waste from the companies' sugar beet operations.

Anaerobic as compared to aerobic treatment was attractive to IGP because it offered potentially lower operating costs, smaller site requirements, and reduced sludge volumes. In addition, the possibility of reducing plant energy costs through the utilization of the biogas was possible. In August 1980, the MOE agreed to IGP's proposal to pilot the CSM system.

6. PILOT TESTS - ON SITE

In December 1980, a six cubic meter "Biothane" up-flow anaerobic sludge blanket pilot unit was installed in the Thunder Bay plant. It was operated continuously for three months during which very valuable data on the anerobic digestion of our particular waste water was gathered. The tests were monitored by both MOE personnel and Dr. E. Hall of the Waste Water Technology Centre.

The "Biothane" started off as the system of first choice due to its simplicity and compactness, an important factor considering the constraints of the plant site. However, by the end of the test period, it was concluded that the digester residence time of 12 to 16 hours was insufficient for the acidification of whole starch granules. As a consequence, these starch granules carried through, causing increased BOD_5 in the effluent and simultaneously creating a less stable sludge. It became clear that anaerobic treatment alone would not provide the consistent reduction of BOD_5 loading required by the MOE. Some form of aerobic polishing would also be required.

The "Biothane" system had been originally conceived as a single-stage anaerobic process. The "Anamet" on the other hand was developed as a two-stage anaerobic/aerobic process.

Consequently, this system appeared better suited to our needs. At this time Sorigona had in operation, seven plants in Europe, and three in the United States. Preliminary data was also available from a pilot plant study in a German wheat starch-gluten plant. Based on this data, IGP's "Biothane" pilot plant operation, and the Control Order schedule a commitment was made to the Sorigona system.

A Certificate of Approval for the system design was received from the Ministry of the Environment.

7. THE ANAMET SYSTEM

The process system is shown in schematic form in Figure 2. It consists of a 5800 cubic metre insulated steel anaerobic mixed bed digester. The contents are stirred with a side-mounted agitator at a temperature of 35 - 38°C. The anaerobically-treated effluent is continuously decanted off and passed through a Lamella inclined plate solids separator in which the anaerobic sludge is separated for return to the digester. The waste water goes to a 450 cubic meter aerobic basin, then to a final clarifier where the aerobic sludge is settled out. The clarified, fully-treated effluent overflows to the river and the aerobic sludge is recycled to either the aerobic basin or to the anaerobic digester for further digestion.

8. CONSTRUCTION

Preliminary site work commenced in July 1981 and a design/supply/install/commission contract was executed with Sorigona in August 1981. The following slides illustrate the constrained site conditions and significant site stabilization work which was required. This work accounted for approximately 20 percent of the project budget of over $3,000,000.

Work continued satisfactorily through the fall of 1981 and spring of 1982. In May, 1982 the project was shutdown for 14 weeks by the province-wide pipefitters' strike. Construction work was completed except for minor deficiences, in November 1982.

9. BENCH SCALE TESTS

Research personnel at John Labatt's Central Research Laboratory undertook extensive bench scale testing to evaluate the specific reaction of IGP's process effluent under anaerobic conditions and to confirm Sorigona's preliminary data from their short-term German wheat starch pilot study.

Effluent was frozen in Thunder Bay and air freighted to London. It was fed to a 12L digester system in which flow rates, vessel sizes, and residence times were in proportion to the full size system.

The test program was continued for a period of 230 days and indicated that the anaerobic/aerobic system would provide an average 94 percent BOD_5 reduction on IGP's waste. Biogas with a methane content of 60 percent - 70 percent was produced at a rate exceeding 94 percent of theoretical. Typical results of stabilized system performance are shown in Figure 3.

10. INITIAL COMMISSIONING RESULTS

Preliminary commissioning activities included filling the digester with city water at a temperature of 40^{o} and adding seed sludge obtained from the secondary anaerobic digesters of the municipal treatment plant.

Initial problems resulting from equipment deficiencies have been resolved and the commissioning program is continuing on a prudent basis. As of June 6, 1983,

the hydraulic loading rate is approximately 45 percent of full load. COD reduction in the digester has been in the range of 85 percent to 90 percent, with a biogas methane content exceeding 65 percent.

11. ENERGY CONSIDERATIONS

Based on the results of the bench tests and the actual commissioning data available to date, Figure 4 illustrates the expected sources and uses of energy in the "Anamet" system.

It is expected that the system will generate in excess of 5000 M^3 of biogas at current plant operating levels. Preliminary engineering has been completed for a gas collection and delivery system to the process boilers which are located 1100 feet from the digester.

In addition to the value of the biogas produced, two additional design features will reduce IGP's overall operating costs:

a. Bran, which has been recovered and sold at a significant loss due to high drying costs, will be added to the effluent stream for treatment by the Anamet System.

   Drying costs will be eliminated and additional biogas produced.

b. Process water, which is heated prior to use is to be heat exchanged with the supernatent from the Lamella clarifier.

   This preheating will reduce fossil fuel requirements.

In view of the significant potential energy savings anaerobic treatment offered, versus IGP's alternatives of aerobic treatment or evaporation/spray drying, (Figure 5) application was made to the Energy Group of the Ontario Ministry

of Industry and Trade for a grant under the Federal/Provincial Conservation and Renewal Energy Demonstration Agreement (CREDA). This program is designed to encourage the demonstration of promising technologies for energy conservation and renewable energy as they apply to industry. IGP has received a grant from the CREDA program, which has assisted in the funding of this project.

CONCLUSION

The facility at Thunder Bay represents the first commercial application of this particular treatment technology on wheat starch wastes. As such, the body of knowledge available to IGP, Sorigona, and the Ministry of the Environment, is limited. It is, in fact, being created by our internal lab work and by the full scale commissioning itself. The support and assistance of the Ministry of the Environment and the Waste Water Technology Centre has been and will continue to be critical to the successful implementation of this system.

IGP is confident that we have chosen the most appropriate technology available for our particular needs and site constraints. It is anticipated that our application will encourage other manufacturers with similar high strength waste to seriously consider anaerobic digestion.

INDUSTRIAL GRAIN PRODUCTS

THUNDER BAY

EFFLUENT CHARACTERISTICS

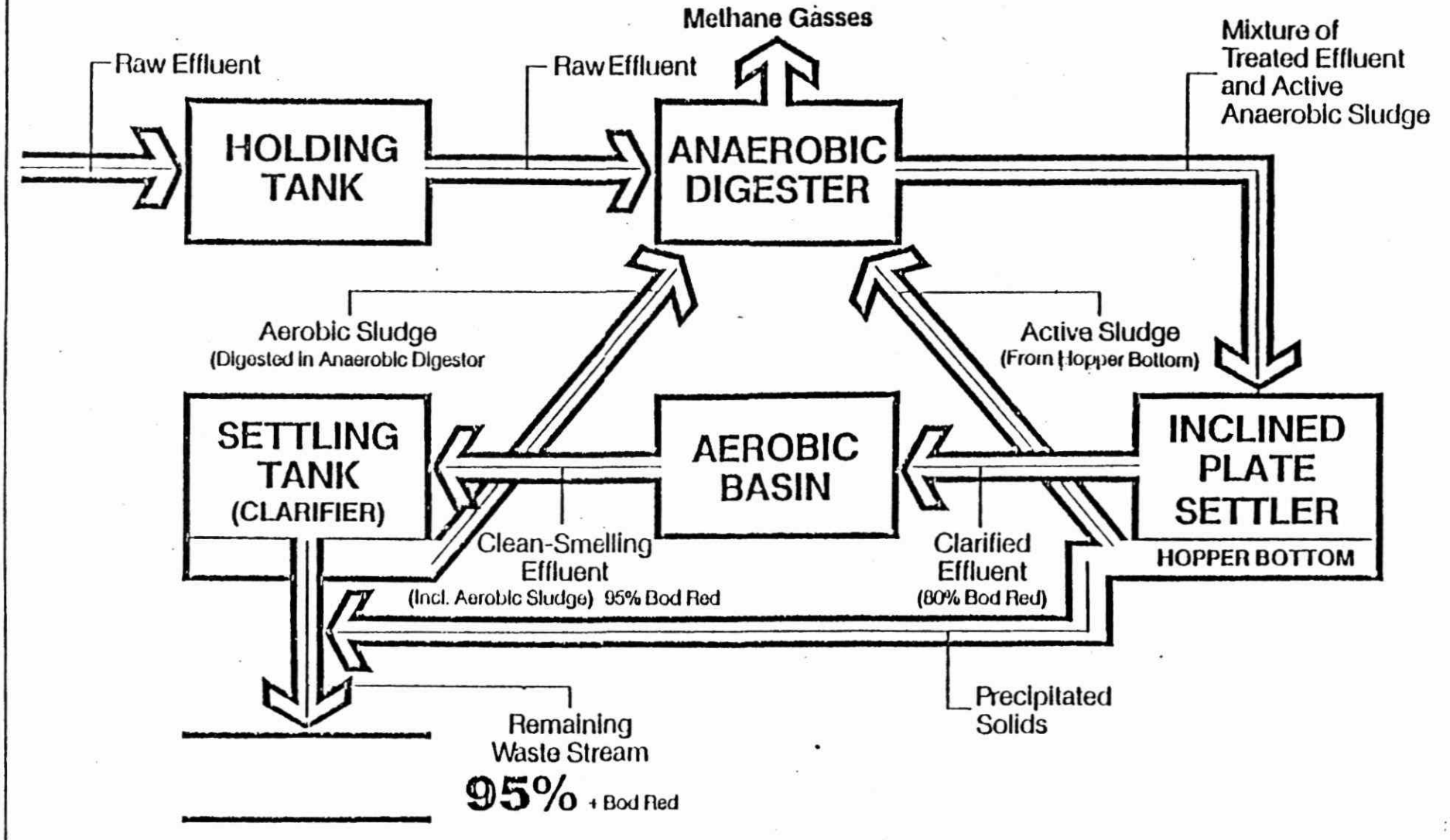
(TYPICAL)

PARAMETER	AVERAGE	RANGE	UNITS
BOD_5	10,400	8,235 - 11,760	mg/L
SUSPENDED SOLIDS	4,000	3,000 - 5,000	mg/L
KJELDAHL NITROGEN	380	350 - 420	mg/L
ORTHOPHOSPHATE	90	80 - 110	mg/L
COD/BOD_5 RATIO	1.7		----
VSS/SS	.99		----
pH	5.4	5.0 - 5.7	----
FLOW	200,000	180,000 - 240,000	IGPD

FIGURE 1

FIGURE 2

Anamet System



INDUSTRIAL GRAIN PRODUCTS

THUNDER BAY

SUMMARY OF BENCH SCALE

EFFLUENT TREATMENT RESULTS

PERIOD: DAY 210 - 220 (10-DAY AVERAGE)

COD LOAD: 2.6 $kg/m^3/day$

BIOGAS PRODUCTION: 1.07 $m^3/m^3/day$

METHANE CONTENT: 65%

PARAMETER	FEED	ANAEROBIC EFFLUENT	FINAL EFFLUENT
TOTAL SOLIDS	11800	4030	3600
VOLATILE SOLIDS	10445	2015	1590
VOLATILE SUSPENDED SOLIDS	2950	800	385
COD - TOTAL	13700	2290	1420
SOLUBLE	10050	875	625
BOD_5	8090	950	480
TOTAL NITROGEN	325	300	200
SOLUBLE NITROGEN	275	200	150
NH_3 NITROGEN	0	190	150
pH	5.6	7.2	8.1

ALL UNITS, EXCEPT pH, EXPRESSED IN mg/L

FIGURE 3

INDUSTRIAL GRAIN PRODUCTS

THUNDER BAY

ESTIMATED ENERGY BALANCE

ANAMET SYSTEM

SOURCES	ENERGY/DAY (Btu x 10^6)	BASIS
BIOGAS	126	80% COD REDUCTION .30M^3 CH_4/kg COD REDUCED
BRAN DRYING CREDIT (DRYER OPERATING COSTS)	25	OPERATING EXPERIENCE
PROCESS WATER PREHEATING	25	OPERATING EXPERIENCE
TOTAL GENERATION/SAVINGS	176	
USES		
EFFLUENT PREHEATING	47	OPERATING EXPERIENCE
ANAMET SYSTEM POWER	9	OPERATING EXPERIENCE
TOTAL USE	56	
EXPECTED DAILY NET ENERGY GAIN	120	
EXPECTED ANNUAL NET ENERGY GAIN	38,400	
(EQUIVALENT MCF: NATURAL GAS)		

FIGURE 4

INDUSTRIAL GRAIN PRODUCTS

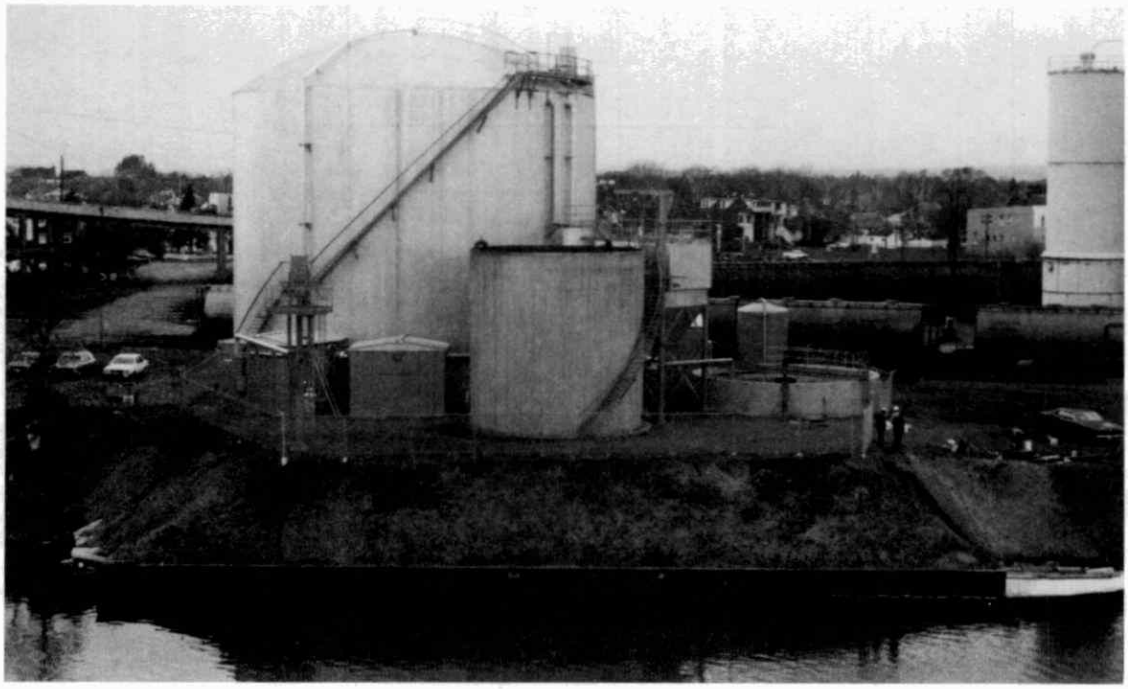
THUNDER BAY

ESTIMATE OF ALTERNATIVE SYSTEM

ENERGY REQUIREMENTS

ALTERNATIVE	NET ANNUAL ENERGY GAIN (USE) (Btu x 10^6)	BASIS
ANAEROBIC/AEROBIC	38,400	FIGURE 4
AEROBIC	(18,700)	EXTERNAL CONSULTANT
EVAPORATION/SPRAY DRYING	(112,200)	IGP EXPERIENCE

FIGURE 5



I.G.P. "ANAMET" WASTE TREATMENT FACILITY--PHOTO DATE: OCTOBER 1982

MECHANICAL COMPLETION: 95%+

BIOLOGICAL COMMISSIONING: UNDERWAY

THE POLYSAR BIOX PLANT

AN INNOVATIVE APPROACH TO DESIGN, CONSTRUCTION, OPERATOR TRAINING AND COMMISSIONING OF NEW WASTEWATER TREATMENT FACILITIES

A.L. ATKINSON
VICE PRESIDENT

AND

D.J. FEATHERSTONHAUGH
DESIGN ENGINEER

MARSHALL MACKLIN MONAGHAN LIMITED
TORONTO, ONTARIO

AND

E.R. FIORONI
BIOLOGICAL OXIDATION MANAGER

POLYSAR LIMITED
SARNIA, ONTARIO

INTRODUCTION

This paper deals with the Polysar Biological Oxidation Treatment Plant (Biox Plant), an industrial wastewater treatment facility located next to the St. Clair River at Polysar's Sarnia facilities.

Polysar produces synthetic rubber, lattices, and other petrochemicals at Sarnia. Many of the effluents from these production facilities are discharged to the Biox Plant for treatment. Some of these effluents have been pre-treated for the removal of oil and rubber which are reclaimed for other uses.

The design, construction and operation of this plant present many interesting and unique features about which to present a paper. This paper, however will only deal with three topics: 1) the close client/consultant working relationship during design and construction (which facilitates a 'fast track' approach); 2) the aeration system (which is the first of its kind in Canada); and, 3) the innovative training and commissioning program that was used for the Biox Plant.

The general layout, process design and some observations on the start-up and operation of the Biox Plant are also briefly discussed.

BACKGROUND

A Ministerial order was given to Polysar by the Ontario Ministry of the Environment to improve the quality of the waste stream that was being discharged to the St. Clair River from the Sarnia facilities. This was part of the overall program to improve the water quality in the Great Lakes.

In order to meet the quality requirements for discharge to the St. Clair River, it was decided that a central wastewater treatment plant would be constructed to treat most of the industrial waste streams.

The combined waste stream has a TOC (total organic carbon) concentration of 100 to 400 mg/l and a phenol concentration of 0.5 to 1.0 mg/l. The Ministry directive was to reduce TOC by 50% and phenol by 75%.

Pilot plant studies were carried out by Polysar for several years prior to design to determine the most suitable treatment process for their industrial waste. Biological treatment consisting of a conventional activated sludge system was found to be the most suitable means of treatment.

It was also confirmed during these studies that control of pH and the addition of nutrients would be necessary.

Flow rates and characteristics were found to be quite variable and dependent on production schedules. Start-up and maintenance operations in the industrial processes result in unpredictable waste flows. It was decided to size the plant for a nominal hydraulic capacity of 24 500 cu metres per day with a peak flow rate of 41 500 cu metres per day and a design strength of 10 000 kg TOC/day and 24 kg phenol/day.

DESIGN APPROACH

Marshall Macklin Monaghan Limited was awarded the design of the Biox Plant in July 1980. The target date for the start-up of the plant was July 1982, just two years later. This short period available for design and construction of the plant necessitated breaking up the project into packages that could be designed, tendered, and constructed individually and concurrently. This permited an early procurement of long-lead items and an advance start on site preparation and major excavation.

The Biox Plant project was divided into the packages which were prepared for tender call in the following order:

- preselection of aeration and clarification equipment
- aeration tanks and pre-treatment
- clarifiers
- electrical and instrumentation
- control building
- chemical feed and yard piping
- site works
- outfall works (marine and onshore)

Each of these packages was organized to provide minimal interference with other work on the project. The sequence of design was such that each package was tendered in time for construction to be completed by July 1982.

While the staging of procurement and construction is not unique on large projects, the speed with which it was achieved is noteworthy. Over 60% of the construction value had been tendered within 3 months of commencing design.

This 'fast track' approach necessitated good communications between Polysar and Marshall Macklin Monaghan. During the design of the major project packages, an office for the Polysar project team was established at Marshall Macklin Monaghan's Don Mills Office. This liaison office was staffed by various members of the project team from Polysar for three to four days per week on a regular basis over a 12 month period.

The liaison office enabled the client/consultant team to establish a close working relationship from the outset of the project, and ensured that the client was able to input actively into the design of the plant. Review of design concepts and detailed design was done mainly from the liaison office, and the resulting time savings in the review process ensured the rapid progression of the design.

It should be noted that the Polysar project team's purpose was not to take over the design of the plant, but to ensure the design progressed as quickly as possible, to minimize delays caused by client requested modifications to the design, and to ensure that each individual project package would fit into the overall project.

The key benefits that were realized from having the liaison office are:

- A close working relationship between the client and consultant teams.
- A faster design process, since review of concepts and designs was accomplished almost immediately.
- A design tailored to suit the needs of the client and the individuals who were to be responsible for operating the Biox Plant.
- The incorporation of engineering standards and specifications consistent with other systems at Polysar.

This close contact was maintained through the construction stages of the project as well. An engineer from the consultant's office was assigned to the project on a full-

time basis for the duration of construction. This provided a link between the design stage and the construction stage of the project. The liaison engineer attended weekly jobsite meetings and was responsible for liaison between the design and construction teams and co-ordination of shop drawing reviews and design modifications.

The use of the 'fast track' cooperative approach to design and construction proved to be very successful. The design began in July 1980, the first stage of construction began in April 1981, and micro-organisms were added to the aeration tanks to start-up the process in December 1982. The plant had been scheduled to start-up in September 1982, but a fourteen week strike by pipefitters delayed the start-up date until December.

The design and construction process took just two and one-half years. Had the entire plant been designed before any tenders were called the project could possibly have taken in excess of four years to complete. The best news is that the plant meets its objectives and was delivered at 10% under budget.

PROCESS DESCRIPTION

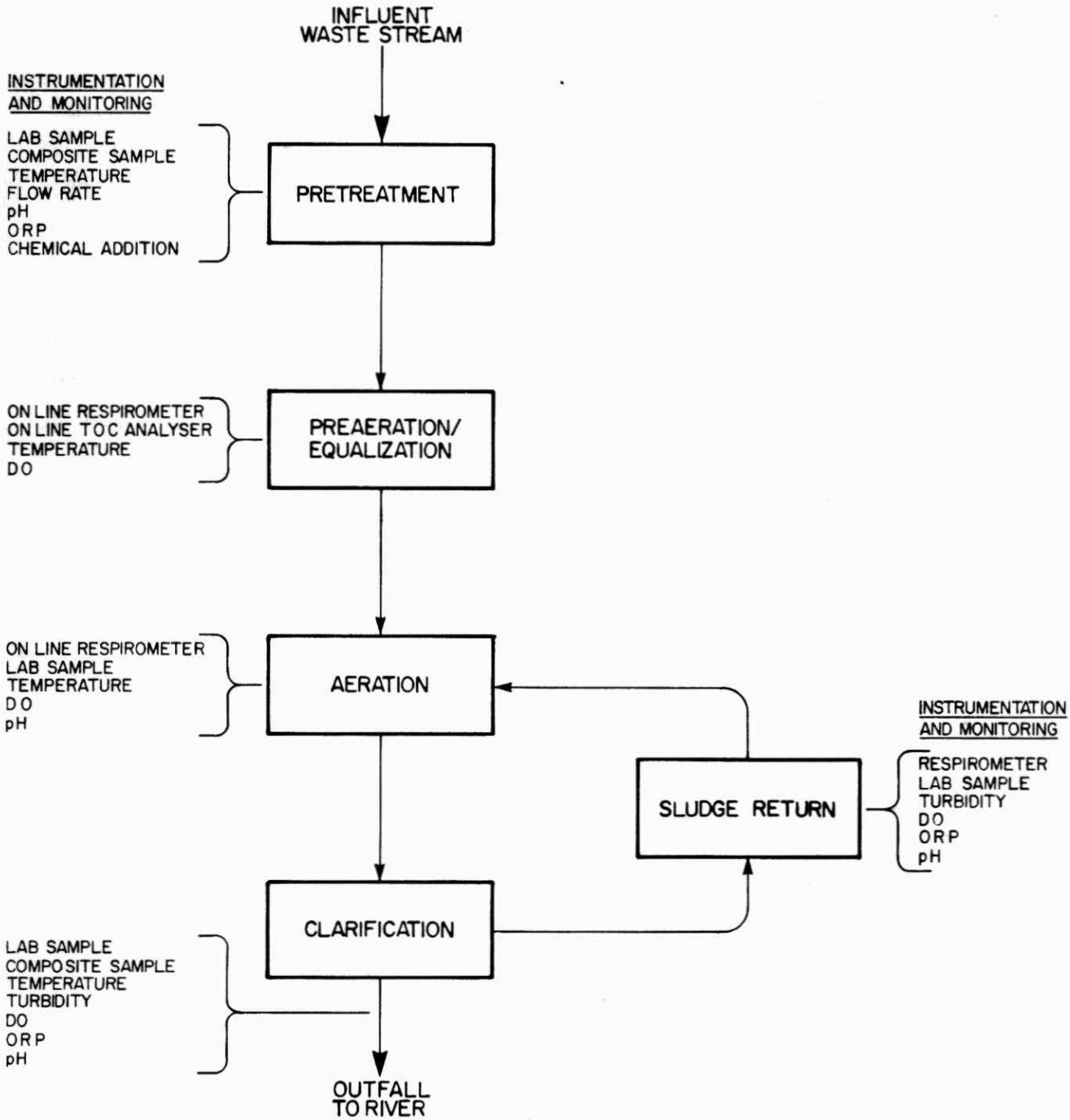
The major process components of the Biox Plant, as shown in Figure 1, consist of:

- pre-treatment
- pre-aeration/equalization
- aeration
- clarification
- sludge return

The pre-treatment section consists of two pH control tanks and eight oil/solids separation tanks.

A mechanical turbine mixer in each pH tank ensures proper mixing of any chemicals that are added to the influent.

Either Sodium Hydroxide or Sulfuric Acid are used to control the pH levels of the influent. Rough adjustment of the pH is accomplished in the first pH tank, and final adjustments to pH are made in the second tank. pH monitors in each tank are used to automatically regulate the addition of acid or base by chemical metering pump control. Based on operating experience, the optimum pH for the biological process is 6.7. To achieve this, the pH in the pretreatment stage is adjusted to about 10.0.



MAJOR PROCESS COMPONENTS

FIGURE 1

If an influent enters the plant with a pH that is too high or low for proper adjustment by the pH control system, then an alarm signal is sent to the plant control centre. Appropriate action can be taken by the operator to keep the toxic influent from flowing to the activated sludge process.

Nutrients are also added to the plant influent at the pH tanks. Nitrogen and phosphorus, which are essential for efficient biological treatment are added as required to the influent. Monitoring the nutrients available in the influent ensures that only the required amounts of phosphoric acid (for phosphorus) and ammonium hydroxide (for nitrogen) are added.

Oil/solids separation is accomplished in eight separation tanks. Floating oil is collected in an oil scum trough and solids, which may accumulate at the bottom of the tank, are drained off by gravity. The oil/solids separation system is manually operated.

The agglomeration of oil present in the wastewater may be enhanced by the addition of ferric chloride, aluminum sulphate or polyelectrolytes, either individually or in combination. These chemicals can be added to the influent at the pH tanks. The rate of addition and combination used will depend upon the wastewater characteristics.

Pre-treatment chemicals are stored in a chemical tank farm area adjacent to the Control Building and are added to the system by chemical metering pumps. Because of the variations that can occur in the characteristics of the waste-water, only the addition of pH control chemicals is automatically controlled. Other chemicals are adjusted by the plant operators based on the results of daily samples taken from the waste stream.

An extensive on-line monitoring program, in conjunction with batch sampling keeps the operators informed of the characteristics of the influent from the time it enters the Biox Plant until it is discharged . Monitoring of the influent in the pre-treatment stage ensures that the chemicals added to the wastewater are kept to a minimum.

The pre-aearation/equalization tank follows the pre-treatment stage. This tank provides equalization of organic loads and flow and pre-aeration of the influent. The pre-aeration results in the partial oxidation of non-carbonaceous COD (chemical oxygen demand).

The normal liquid depth in the pre-aeration tank varies between 7.5 and 10 metres, and provides approximately three hours of hydraulic retention or about 3 200 m^3.

In the event that a toxic influent enters the plant, the pre-aeration tank can be used to contain this influent, and prevent it from reaching the aeration tanks, where it could damage the biomass. The contents of the tank can be discharged directly to the plant by-pass to protect the aeration tanks from undesirable influent.

The aeration tanks follow the pre-aeration tank in the wastewater flow through the Biox Plant. There are four aeration tanks, each one is 20 metres wide and 30 metres long with a 10 metre side water depth, giving a volume of 6 000 cubic metres per tank.

Aeration and mixing are accomplished by a jet aeration system. Each aeration tank has three distribution headers for the jet aeration system. Air is suplied to these headers by a central air blower. Each header has a recirculating pump which pumps liquid from the aeration tank through the header and back into the tank through a jet nozzle. These pumps are each rated at 236 l/sec (3 750 USGPM). Air is mixed with the liquid in this nozzle.

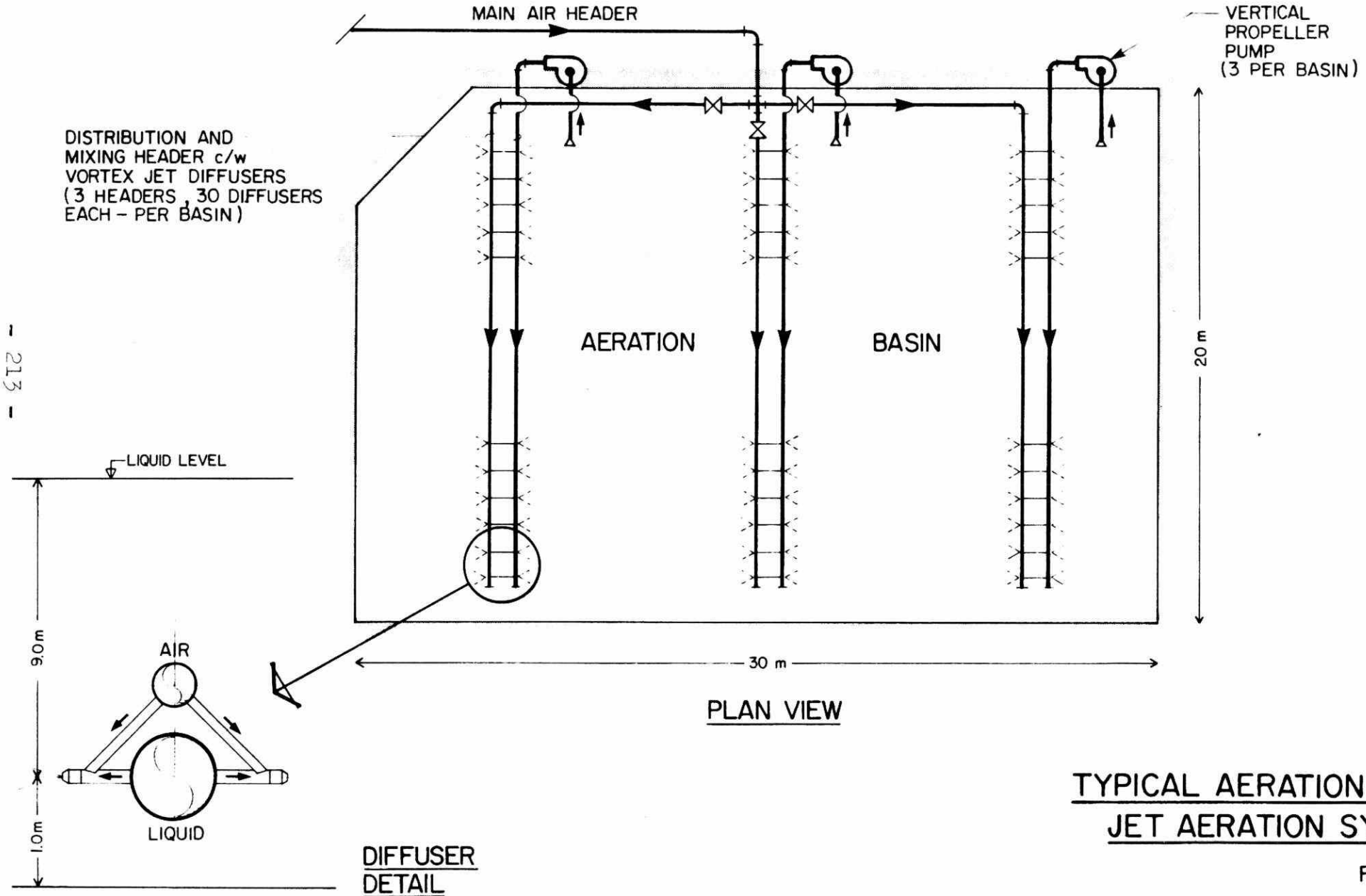
Oxygen transfer and mixing are provided by these jet nozzles. The discharge from the nozzle provides a roll-over type mixing in the tank. Oxygen transfer is obtained when the liquid and air are mixed in the nozzle, and by transfer from bubbles during their extended rise to the surface.

Each header has thirty nozzles on each side located approximately one metre above the floor of the aeration tank. The liquid depth in the tank is ten metres. The general layout of the jet aeration system is shown in Figure 2.

The four aeration tanks are arranged so that either complete mix or plug flow type regimes can be used.

With complete mix aeration, the influent is uniformly distributed to all four tanks. Each tank overflows a weir along one side of the tank. The complete mix system can handle surges in organic loading with minimal change in effluent quality. Return sludge from the clarifiers is equally distributed to all four tanks for complete mix.

Two types of plug flow are possible. With dual stage plug flow, influent enters one of two tanks, and flows into the adjacent tank through a submerged pipe. Four stage plug flow has influent entering only one tank and flowing, in series, through the other three tanks before being discharged from the aeration system.



TYPICAL AERATION BASIN JET AERATION SYSTEM

FIGURE 2

Return sludge distribution from the clarifiers is controlled for plug flow, with most of the sludge being directed to the first tank, with a diminishing amount of sludge going to the subsequent tanks.

The plug flow configuration is superior to complete mix in its ability to avoid the short-circuiting of untreated wastewater during peak flow periods.

The aeration system is designed to maintain a DO (dissolved oxygen) level in the aeration tank between 2 and 4 mg/l. Air input to each aeration tank is based on the DO level in the tank. DO is monitored on a continuous basis. Air flow control is achieved by varying the blower capacity and throttling the airline to each tank. By throttling the airlines, air flow to each tank can be varied to suit plug flow conditions. Complete mixing can be achieved by liquid pumping alone, thus allowing the complete shut down of the compressors.

The pre-aeration tank utilizes a similar system for aeration.

The aeration tank effluent is discharged to four gravity clarifiers. The poor settling properties predicted by the pilot plant studies dictated a clarifier design with low hydraulic and solids loading rates. The design overflow rate for the clarifiers is 10 $m^3/m^2/d$.

Chemicals can be added to the clarifier influent to improve the settling characteristics. Aluminum trichloride, a waste product produced at Polysar, has been used in combination with 0.5 mg/l of anionic polymer to improve settling, and has avoided the need for other commercial chemicals.

The sludge blanket level in the clarifiers is controlled by variable speed recirculating pumps. Level sensors are used to control the speed and capacity of the pumps to maintain a stable sludge blanket level.

Three sludge pumps are provided to recycle settled solids from the clarifiers to the aeration tanks. Sludge pumping capacity can be varied from 50 to 200% of average design flow by means of motor speed control.

Process control of the plant is achieved by a data acquisition and control system. A central operators' control console located in the Control Building allows the operator to control and supervise the operation of the Biox Plant. To accomplish this, the control system will perform the following functions:

- Input monitoring of flow readings, level, temperature and chemical analyses;
- Signal conditioning and conversion to engineering units of inputs from monitoring equipment;
- continuous analogue and sequential digital control of chemical feed rates, aeration blower air flow and sludge recirculation rates;
- Alarm detection and annunciation;
- Display of operating data via an interactive display terminal;
- Long-term storage of process data.
- Hard copy print out of data in tabular and graphical form.

In addition to a very comprehensive range of automatic sampling devices, a continuously operating respirometer checks the treatability of the incoming waste.

AERATION SYSTEM

The selection of an aeration system is one of the more critical factors in designing an effective activated sludge system. An aeration system that does not satisfy oxygen transfer and mixing requirements will result in poor process performance. At the same time, aeration usually requires the highest energy input to the system, and any reduction in power requirements will translate directly into reduced operating costs for the plant.

The energy efficiency of the aeration system was, therefore, a prime consideration in the selection of an aeration system for the Biox Plant.

The size and shape of the property that the Biox Plant is built upon also played a key role in the design of the aeration system.

The combination of limited space, the need to provide for future expansion and the retention time that pilot plant studies had shown necessary for biological treatment made the use of large, shallow aeration tanks undesirable. The alternative chosen was deep basin type tanks, which would reduce the surface area required for aeration.

Analysis of the available aeration systems on the market suggested two types of aeration systems as being suitable for the deep tank configuration of the Biox Plant. These two types are the static mixer type and the jet mixer type.

The static mixer aeration system consists of air diffusers located throughout the bottom of the aeration tank. Both mixing and oxygen transfer are achieved by air bubbles emitted from the diffusers.

The jet mixer aeration system mixes air and wastewater together and discharges this mixture into the aeration tank through nozzles located on the bottom of the tank. These nozzles discharge horizontally. Oxygen transfer occurs both when the air is mixed with the wastewater in the nozzle and when the bubbles from the jet nozzle rise through the wastewater. The air/wastewater discharging from the nozzle and the rising action of the air bubbles provide the mixing action in the aeration tank.

Tenders were received for two static type systems and two jet type systems. The tenders were analyzed and compared on the basis of capital, operating and maintenance costs.

The system that was found to be most suitable for the Polysar Biox Plant was the jet type aeration system manufactured by Aerocleve-Clevepak.

This system, while more expensive to purchase than the static type systems, provided significant savings in operating costs, and was judged to have the lowest maintenance requirements. The equivalent annual cost for the system over a twenty year life proved to be the lowest of all the systems.

The jet aeration system also provides a built-in back-up capability, since if a recirculating pump fails, then air supply can provide mixing in the tanks, and vice-versa.

The jet aeration system is well suited to a deep tank configuration. It provides an oxygen transfer efficiency as high as 3.6 kg O_2/kW hour (6 lbs. O_2/hp hour), and the jet action ensures sufficient mixing in the aeration tank.

The high oxygen transfer efficiency means that less air is required for this type of system than for the static mixer type system. The static mixer had almost twice the air requirements of jet aeration.

The jet aeration/deep tank system for the Polysar Biox Plant is the first installation of its kind in Canada.

The jet aeration system requires a high volume, low pressure air supply (24 500 m^3/h at 102 kPa). Due to the variable quality and quantity of the wastewater to be treated, it was also desirable to have an air supply that could be varied to suit the air requirements in the aeration tanks.

Tenders were received from six different manufacturers for an air supply system to suit the selected aeration system. An analysis and comparison similar to the one performed for the aeration system was done for the air supply system.

The basic type of air blower systems evaluated were vertically-split centrifugal, horizontally-split centrifigual, and variable diffuser vane centrifugal. Volume control on the vertically and horizontally-split centrifugal blowers is by means of suction throttling. The variable vane blower controls discharge volume by varying the angle of the vanes on the impeller.

The variable diffuser vane blowers were found to be the most economical when compared on the basis of equivalent annual capital and operating costs over a 20 year period. The blower chosen for the Biox Plant was a Cord Turbo variable diffuser vane blower. The efficiency of this type of blower remains relatively constant throughout the entire operating range, at approximately 80%. The capacity can be regulated between 45% and 100% with a constant delivery head by changing the pitch of the variable diffuser vanes.

Three of these blowers are used. One blower can provide low volume air requirements, and two blowers in parallel provide the peak volume requirements. The third blower is standby.

This is the first installation of this type of blower in North America, although these blowers have been successfully used for wastewater treatment in many European countries.

The three blowers are housed in a separate building next to the aeration tanks. No other equipment is located in this building due to the noise levels that are generated when the blowers are in operation. The acoustical design of the blower building ensures that the noise levels outside the building are minimized.

Reliability and maintenance were carefully evaluted for both the blower and aeration systems. Although there were no similar installations in Canada, the installations in other parts of the world were evaluated and through comparisons with conditions in Sarnia, an estimate of reliability and maintenance was made.

To-date, both systems have been operating as they were designed and no major problems have occurred. The jet aeration/variable diffuser vane blower combination is an economical and reliable method of aerating a deep tank activated sludge system.

While this type of system will not be suitable for all aplications, it is certainly worth considering as an option during the preliminary design stages of an activated sludge system.

The 'fast track'/cooperative approach to design and construction has proven itself to be a useful approach for the Polysar Biox Plant. This approach was successful in having the design and construction complete in two and one-half years, however, the project did not end there. The operator training and commissioning program was the next stage in ensuring that the Biox Plant was put into operation in a short time, at minimum expense and with minimum start up problems.

TRAINING PHILOSOPHY

The capability to train operators exists. The questions that were difficult to answer at the start were: Can we "educate" people to take advantage of the training opportunities available but most of all, can we teach upper Management what an operator is? And if we are able to teach them, will they believe us?

It is well known that strange ideas prevail in the outside world that wastewater operators are not required to have broad technical knowledge.

Having realized that we were dealing with a powerful union, our first obstacle was to convince the Union that we requird experienced and skilled operators in the wastewater field. Our second objective was to communicate this information in a favourable manner to upper Management. At the beginning, it was very difficult for them to understand the validity of our convictions. They could not visualize "waste" requiring individuals that needed extensive experience and adequate training.

Looking back, the task of educating people not involved in the process itself was the most difficult hurdle to overcome. How did we achieve this goal? We gave some very sad examples of how major bioxidation plants were unable to meet the desired requirements because of lack of proper pre and post start-up training.

After long and difficult communication meetings, the authorization was given by upper Management and the Union to come up with an extensive and satisfactory training program.

At this point, we divided our training requirements into three parts:

- o Pre-Start-up Training
- o Start-up Training
- o Post Start-up Training

PRE-START-UP TRAINING REQUIREMENTS

It was decided that the Biox Plant would require six operators, six operator assistants, two maintenance people, a Process Engineer, a Foreman, a Secretary and a Plant Manager.

The following was the timetable suggested:

o	Plant Manager	on-site	2 years in advance
o	Processs Engineer	on-site	18 months in advance
o	Foreman	on-site	15 months in advance
o	Operators	on-site	12 months in advance

1. We initially recommended to hire all the six operators from outside Polysar which could give us a solid baseline of experience and knowledge. Due to union pressure, we were only able to obtain three outside operators. These three individuals all possessed University Degrees, 6-20 years of wastewater experience and were very well versed on activated sludge problems and start-up procedures.

2. Our next step was to hire the remainder of the required operators and assistants within Polysar. We decided to request the top individuals that were interested in working in an Activated Sludge Plant. The interest was very high as over 100 applied for the job. That made it much easier in obtaining top operating staff within the plant.

3. One of the problems associated with wastewater treatment plants is that operating personnel do not stay on the job for very long, causing discontinuity and lack of knowledge derived from minimal on-site experience. We had to develop a sound, progressive training program to ensure that our operators would consider their job a permanent one.

4. The decision was made that the only way the operators could leave the Biox Plant was if they personally choose to post out. This decision enabled us to ensure the permanency of "Biox Operator" and allowed us to design a solid progressive certification program.

5. In Polysar, laboratory technicians have a different job description than process operators, and one cannot perform the other's duties. Therefore, we had to design a job description that would fit both categories and at the same time be satisfactorily accepted by the Union. We did this by convincing Management and Union that the operator will be efficient, if he personally performs the required tests and does the actual interpretation. This dual responsibility will make his job more enjoyable.

6. Since process control will be achieved by a data acquisition and control system (DACS) which is to include a central operator's console and process interface cathode ray tube (CRT) units, the operators had to be properly and thoroughly trained to operate and understand the computer system.

   A training program consisting of three full days of theory, and three full days of practical application was given four months prior to the targeted start-up date. This program would help the operator in:

   (a) understanding the console operation and how to properly interpret data through process control.

   (b) minimize the sense of mystique and terror that the monstrous but simple machine gave to individuals that were not properly trained.

Every operator, assistant operator, foreman, engineer, secretary, all instrument people and maintenance personnel took the course.

Although the course was an excellent tool, we strongly recommend that this type of training be carried out during or just before actual start-up. Our course was repeated three weeks before start-up.

7. At this stage, having permission to hire three outside operators and to obtain the top candidates from within the plant, we established a permanent position for our personnel and were successful in outlining the responsibilities of the operators within their job description.

One key item was still missing: we had to convince Management that we required these individuals at least six months to one year before the plant actually was operational. During this time frame, we would ensure proper operation and maintenance of the wastewater system, in accordance with the design to achieve maximum plant performance and efficiencies of treatment.

We established certain requirements necessary for a professional and effective training program. The trainer would be able to:

(a) correctly define and categorize problems and determine whether they can be solved through training;

(b) analyze the tasks performed at the plant in order to determine the training needs;

(c) determine the type and level of knowledge required for each task;

(d) specify instructional objectives which will be taught to the employees;

(e) develop evaluation activities to determine the progress of students and the effectiveness of the training itself;

(f) choose the best method of instruction for specific objectives;

(g) choose and create effective media for different types or levels of objectives;

(h) communicate with other people on the job site;

(i) deliver a lesson effectively;

(j) revise and evaluate training materials in order to remain current in a dynamic profession;

(k) develop a training schedule.

8. The first six months would be dedicated to achieving the above. The next six months would require training the remaining operating personnel and a training schedule was prepared.

There was one major concern: nine out of the twelve operators had no biox experience. We decided to install a major pilot plant so that our operators could use it as a training and learning tool. Two identical separate systems were built.

Each system consisted of:

One	-	400 litre feed tank (with agitator)
One	-	78 litre aeration tank, the aeration system was under continuous agitation with air flow control
One	-	21 litre clarifier with rotating mechanicsms, 1-5 rpm
Two	-	parastaltic pumps (0-500 ml/min.) for feed and return sludge

With the aid of the Pilot Plant, the operators would learn how to define a problem and find its possible solution. They gained expertise in how to operate instruments and laboratory machinery, but most of all they were able to understand that an activated sludge plant will offer many problems that will require interpretation gained by a solid technological approach (i.e. actual microscopic analysis and interpretation). The operators very quickly learned NOT TO OVERREACT.

9. Our last pre-start-up objective was to send the operators to an operating activated sludge plant, within our area, for a few days to give them some practical experience. Every operator was sent to an activated sludge plant for three days with very positive results. It was at this time that we realized how effective our training up to that point had been. Our operators had more basic knowledge than most of the other operators they talked to. This was primarily because we were able to obtain our personnel one year before start-up but also because we had made our job description a permanent one. From this, we made a serious commitment to ensure our operator's continuity and job security within the Biox.

Summarizing, let us analyze the pre-start-up achievements:

(a) defining the basic need for manpower;

(b) obtaining personnel with practical experience and vast wastewater knowledge;

(c) instituting a security in the job requirement to ensure the operators will not move;

(d) ensuring that the job description included a clause for operators to have dual responsibilities: laboratory and process;

(e) developing training schedule;

(f) obtain all operating personnel six months to one year before actual start-up;

(g) construct and operate a miniature pilot plant;

(h) visit other Bioxidation Plants within specified area;

(i) training.

START-UP TRAINING REQUIREMENTS

The start-up procedure, at this point, was well established through the use of the Pilot Plant. The operators, with the aid of the Pilot Plant, were able to actually experiment and collect data in determining which method would be most advantageous.

After analyzing all the various facets of our needs, we decided that our operators should be involved in overseeing the final phase of the construction. This would satisfy two major requirements:

(a) it would give the operators hands-on-experience of all equipment (actually see the internals), lines, laboratory facilities and all pumps. By comparing in detail the drawings with the actual construction, the operators would be able to point out outstanding errors and possibly have an early input in design changes. In short, they will be able to learn how the plant physically operates.

(b) It would ensure that all design and construction parameters were met satisfactorily before the plant became direct responsibility of Biox team.

The following is how we assigned responsibilities during this period:

Operator 1	-	Clarifier area
Operator 2	-	Underground and overhead piping and pipe gallery
Operator 3	-	Laboratory and building
Operator 4	-	Mechanical areas and chemical area
Operator 5	-	Aeration and preaeration
Operator 6	-	Pretreatment, oil separation and instrument room

We also had to train other Polysar personnel to understand what a Biox Unit was and its purpose within the overall plant structure.

We initiated sound and professional short presentations outlining the plant design and trying to explain what the consequences could be if effluent conditions were not met. Our objective was to instill in our other units not only a sense of appreciation for the high technology required and a devotion needed within Biox but also to ensure a sense of respect and loyalty to our plant. We had to radically change ideas and conceptions that are vividly exemplified by the common statement: "Don't worry, send it to the Biox Plant, they will take care of it."

These presentations last 30 minutes followed by one hour discussions repeated four to five times during the first year of operation.

POST START-UP TRAINING FORMAT

To minimize labour management relations, it was mandatory to outline a certification program and make it part of the job requirement. Certification ensures the following:

1. It will allow operators to maximize their potential.

2. It will ensure that the operators will perform with the most innovative and modern technology.

3. It will motivate the operators to continuously learn new technology, operation strategy and will also enable them to more clearly understand the intricate problems associated with the Biox Plant.

4. It will ensure an overall "good feeling" amongst the entire crew arising from self confidence and ability.

5. It will save Polysar a tremendous amount of dollars:

    i) dollars derived froma better D.O. control (less electrical costs);
    ii) dollars derived from an overall improved control (less maintenance costs);
    iii) dollars derived from ability to interpret results and make necessary changes that will avoid major problems;
    iv) dollars derived from an overall better environment and increased work production.

The certification of operators will be based on experience, education and examination with provision for limited substitution of education and experience with each other under an approved system.

Formal education can be supplemented by approved training courses, seminars, etc. for which C.E.U.'s (continuing education units) are allocated.

Considering the fact that in Ontario, there is no mandatory or voluntary certification program as of yet, it is noteworthy that we, at Polysar, have developed a four phase training program that will eventually lead to a complete certification when it is established in this province.

Let us look at the four phase training program developed:

Phase I - Basic

This phase is intended to give the staff a review of Grade 12 and first year college subjects that they will require in the every day operation of the plant. The subjects are:

Mathematics	(16 units)
Chemistry	(8 units)
Biology	(2 units)
Physics	(2 units)
Microbiology	(3 units)

Each operator will be writing a pre-test on each subject. The result of the test will enable us to place them in the appropriate level. Some operators will not require this first phase and will automatically go to Phase II. This will be all in-plant training. In order to institute an effective in-plant training program, existing technical personnel were utilized in development and delivery. We expect an operator to complete Phase I within three to six months.

Phase II

During this phase, they will be taking a basic laboratory course, developed and implemented within the plant.

They will also start having hands-on-experience through the digestion and understanding of the Operation and Maintenance Manuals.

The objective of this phase is to introduce them to the laboratory technology (theory and practice) and also allow them to slowly digest the operation of the plant via a practical approach. This should take approximately six months to one year.

Phase III

During this phase, the operators will be concentrating on an advanced laboratory course where they will learn to accurately interpret results and make necessary changes. During this phase, they will attend the "APPLICATION OF ON-LINE RESPIROMETRY AND OTHER ANALYTICAL INSTRUMENTATION PROCESS CONTROL COURSE."

We feel that this course is imperative since our operational strategy is based on respirometry and D.O. control. At this course, they will be exposed to a practial approach in understanding the science of respirometry and settling properties.

They will then attend a 60-hour wastewater course at our Community College. This course is a prerequisite for Level IV. This phase should take approximately one year to eighteen months.

Phase IV

At the completion of Phase III, the operator is now ready to undertake the Ministry of the Environment Courses offered in Toronto. We have chosen eight courses to be taken over a period of three years.

MINISTRY OF ENVIRONMENT COURSES

	Course	Experience	Education	CEU	Pre-Requisites
1.	Basic Sewage Treatment Operation	6 Months	Lambton College	3.0	Lambton College
2.	Activated Sludge Workshop	1 Year	Lambton College	3.0	Course No. 1 + Lambton College
3.	Primary Treatment & Digestion Workshop	1 Year	Lambton College	3.0	Course No. 1 + Lambton College
4.	Basic Water Treatment Operation	1 Year	Lambton College	3.0	Lambton College
5.	Surface Water Treatment	18 Months	Lambton College	3.0	Course No. 1 + Lambton
6.	Pump Operation Workshop	1 Year	Lambton College	3.0	Lambton College

MINISTRY OF ENVIRONMENT COURSES

	Course	Experience	Education	CEU	Pre-Requisites
7.	Laboratory Skills	2 Years	Lambton College	3.0	Course No. 1 or 3 and Course No. 2 + Lambton College
8.	Advanced Water/ Wastewater Treatment	3 Years	Lambton College	3.0	Course No. 2 or Course No. 5 + Lambton College

At this stage, the operator will possess the experience supplemented by adequate training to be considered a "qualified wastewater operator." This will be to his advantage when certification becomes compulsory.

Summary of the four phase training program:

Phase I

Basic Knowledge
- Mathemetics (16 units)
- Chemistry (8 units)
- Biology (2 units)
- Physics (2 units)
- Microbiology (3 units)

UP TO 6 MONTHS

Phase II

- Introductory laboratory course
- O&M exposure with hands-on-experience

6 MONTHS TO 1 YEAR

Phase III

- Advance laboratory course
- Attendance of course: Application of On-Line Respirometry and Other Analytical Intrumentation to Process Control
- Wastewater Course at Community College (60 hours)

1 YEAR TO 18 MONTHS

Phase IV

- 8 Ministry Courses, duration 1 week each

2-3 YEARS

PLANT OPERATION

The plant started up on December 8, 1983 and immediately (after 10 days), the desired M.O.E. requirements were met. The T.O.C. was reduced by 50% and the Phenolics by 80%.

The results in the last six months are outstanding, even with major problems, our operators were able to quickly implement corrective actions to prevent any major disaster. Our maintenance costs are minimized, our energy costs are optimized and we did not require any outside chemical addition.

We can conclude at this time that the training program coupled with the flexible and well designed plant were the two key ingredients for a successful, operational plant.

CONCLUSION

Effective training is not an accident but is a systematic approach. The mechanics of planning the training itself leads to both a pre-start-up program and continuing training for company personnel. We feel that proper training is the single most important tool in a well operated unit.

Constructing, expanding and upgrading wastewater treatment facilities present numerous employee related problems as well as technical difficulties. Prior planning and training will pay off in the reduction of problems that will occur during the initial start-up period and the subsequent operating period. To ensure a complete cost effective and productive operation, the following four factors should be considered:

1. PROPER DESIGN to allow for process flexibility and controllability.

2. CLOSE CLIENT/CONSULTANT WORKING RELATIONSHIP during design and construction which facilitates an efficient and timely design.

3. INSTRUMENTATION (on-line and laboratory) to allow for process information to be readily available.

4. SOLID AND ESTABLISHED TRAINING PROGRAM so that the operator can learn to properly interpret process information and apply it to a flexibly designed plant.

DEINKING AT ONTARIO PAPER

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Introduction

The Ontario Paper Company has just completed a $260 million modernization and expansion of its Thorold operation. The project has involved two major changes. Outdated groundwood pulping facilities have been replaced with modern pulping systems including thermomechanical, chemimechanical, and a deinking plant to process 100,000 tons of recycle newspaper per year. The other major change was to replace five small newsprint machines with two modern high speed twin wire units with 300 inch trim.

Capacity of the mill was increased from 240,000 tons a year to 340,000 tons per year. The expansion required more fibre than was available from Company forest limits. However the new pulping processes make better use of the fibre sources available to the Thorold mill. The chemimechanical process utilizes hardwood and will enable the mill to use much larger quantities of poplar than previously possible. Nevertheless, most of the fibre for the added production comes from recycle newspaper which makes up 25% of the total mill furnish.

Waste News Procurement

Thorold is located within 250 miles of major metropolitan areas in Ontario and the Great Lakes states and has good access to recycle newspaper. To give you some idea of the magnitude of the task, the annual requirement would fill a 15-story building the size of a football field.

Ontario Paper has established a joint venture company, Ontario Paper Recycling Inc., to supply the mill with recycle paper from Canadian sources. Its partner is Consolidated Fibers Ltd., a major waste paper dealer in Canada and the United States. The new company works closely with municipalities, dealers, schools and community groups to contract for old newspaper. Warehousing, baling facilities, buy-back centres and a new trucking company to transport paper have been established to assist in the collection.

In the U.S., the mill buys directly from established dealers in the major cities bordering the Great Lakes. Until a sustained inflow can be built up in Ontario about half the requirements will come from the nearby U.S. centres.

Waste news quality is critical. The mill can handle regular daily or weekly newspaper editions including inserts and supplements. However magazines, boxes, cartons and telephone books are not acceptable since they contain clay and glue that cause problems in the newsprint mill.

Beloit Deinking Process

The Beloit deinking system differs from other washing type systems in that it is composed of two loops -- the black or hot loop and the grey or acid loop, each with its own flotation clarification system. The advantage of the two-loop system is to be able to recycle excess pulping chemicals back to the pulper. This has the overall effect of cutting pulping chemicals in about half and also reducing clarification chemicals in the alkaline loop. Make-up water is very small, reducing costs of

chelating agent for water treatment and also reducing steam requirements. The cost of the chemical used for clarification in the acid loop is relatively low. However the two loops must be isolated so no recovered water is recycled from the acid loop to the alkaline loop as it contains alum that would tend to redeposit ink on the fibre.

BLACK LOOP

Pulping

Waste paper is moved by a loader from storage and approximately 4 tons dumped into one of the two charging buckets. The two batch pulpers alternate on a loading, pulping and dumping cycle and all charging of waste news and chemicals is automatically controlled. In essence the deinking process is one of laundering very much like washing clothes or dishes. The charge in addition to waste news includes clarified black liquor containing recycle chemicals, make-up chemicals including sodium silicate, a chelating agent and a detergent. For effective deinking it is essential that the ink be completely removed from the pulp and dispersed to a very fine particle size. Unless finely divided the ink will not be removed in subsequent washing steps.

Contaminant Removal

After about 20 minutes pulping the charge, at about 6% consistency, is pumped to the continuous pulper and diluted with further clarified recycle liquor to about 3.6% consistency. The continuous pulper contains a ragger and junk box to remove contaminants such as plastic, rope and wire. Additional pulping also takes place. The pulp then goes through

high consistency cleaners to remove foreign material such as sand, metal and glass. The pulp is subsequently processed through a Belcor cleaner, which is a combination heavy-duty secondary pulping unit and screen which removes light and heavy contaminants such as plastics. The light fraction is screened on a vibratory Hooper screen to reclaim fibre and separate the plastics. The good fibre is recycled to the continuous pulper.

Ink Separation

Accepted fiber from the Belcor is pumped at a constant flow rate to four horizontal screw presses equipped with horizontal predrainers. The consistency is raised from 3.5% up to about 20-25%. It is important to maintain as high a discharge consistency as possible for maximum ink separation and maximum chemical recovery. About 90% of the ink is separated at this point in the process.

Clarification

The black pressate from the first stage presses is treated with a combination of two polyelectrolytes to flocculate the ink and fines which are subsequently separated by flotation in a Krofta clarifier. The clarification utilizes the principle of dissolved air flotation. Air is dissolved in the effluent under pressure. On releasing the pressure, tiny bubbles are formed which attach to the preflocculated fines and float them to the surface of the clarifier. The concentrated layer of ink and fines is continuously scooped off and sent to the secondary treatment plant. Clear liquor is withdrawn from the bottom of the Krofta clarifier for recycle.

GREY LOOP

Screening and Washing

The high consistency pulp from the first stage press is diluted with recycle water from the grey loop clarifier to about 1.1% consistency and pumped to two Beloit pressure screens. Accepted stock passes through a slotted screen basket while plastics, fibre bundles and other foreign material cannot pass and are rejected. The rejects are diluted to about 0.9% consistency and screened through a secondary pressure screen. Accepts recycle to the primary pressure screen and the rejects are sent to a tertiary vibrating Hooper screen. The rejects are rejected and accepts returned to the secondary pressure screen.

Accepted stock is thickened to about 4.8% consistency on one of the four third stage decker washers to remove more ink.

Clarification

The effluent from the deckers is treated with alum and polyelectrolyte and the flocculated ink and fines separated by air flotation in two Krofta clarifiers in the same manner as with the black pressate.

Fourth Stage Pressing

The pulp discharged from the decker washers is sent to four horizontal Beloit screw presses and the consistency raised to about 20%. The pulp is reslurried in hot common cloudy white water from the paper mill to about 3.8% consistency and stored in the Deinking Blending Tank. The normal output of the deinking plant is about 235 O.D. tons per day pulp.

Operating Problems

The two most serious problems to date have been foaming and difficulty in deinking old waste paper.

Extensive studies have been made to identify a suitable detergent that effectively removes and disperses the ink without excessive foaming. We have made good progress in this direction but are continuing to evaluate new products which may be even better. In general the detergents that are most effective for deinking also have the greatest tendency to foam.

Over a period of time ink appears to set up and becomes very difficult to remove from the paper. The only solution to this problem is to keep inventories at a minimum and try to procure paper that is less than six months old.

EFFLUENT TREATMENT PLANT

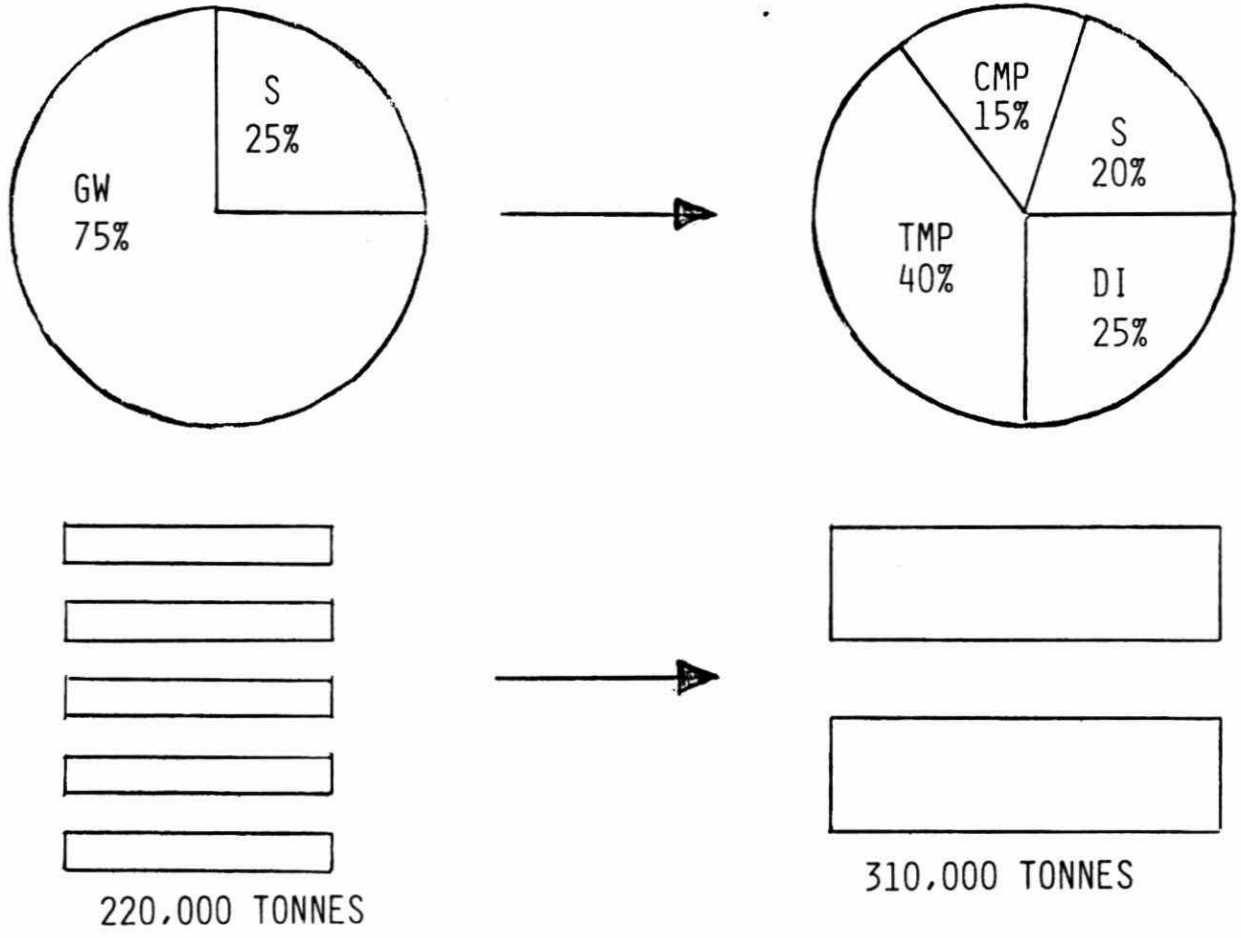
Primary Treatment

The main purpose of the primary treatment is to remove settleable and floatable solids from the mill waste streams. The unit was supplied by Eimco Envirotech and is 150 ft. in diameter and 8.9 ft. sidewall depth. With a flow of 450 Imperial gallons/sq.ft./day the retention time is about 3.6 hours. The settled solids are separated on an Eimco belt filter and disposed of to landfill. The filtrate and primary clarifier overflow are given secondary treatment in a UNOX activated sludge system to reduce the B.O.D. to an acceptable level before discharge.

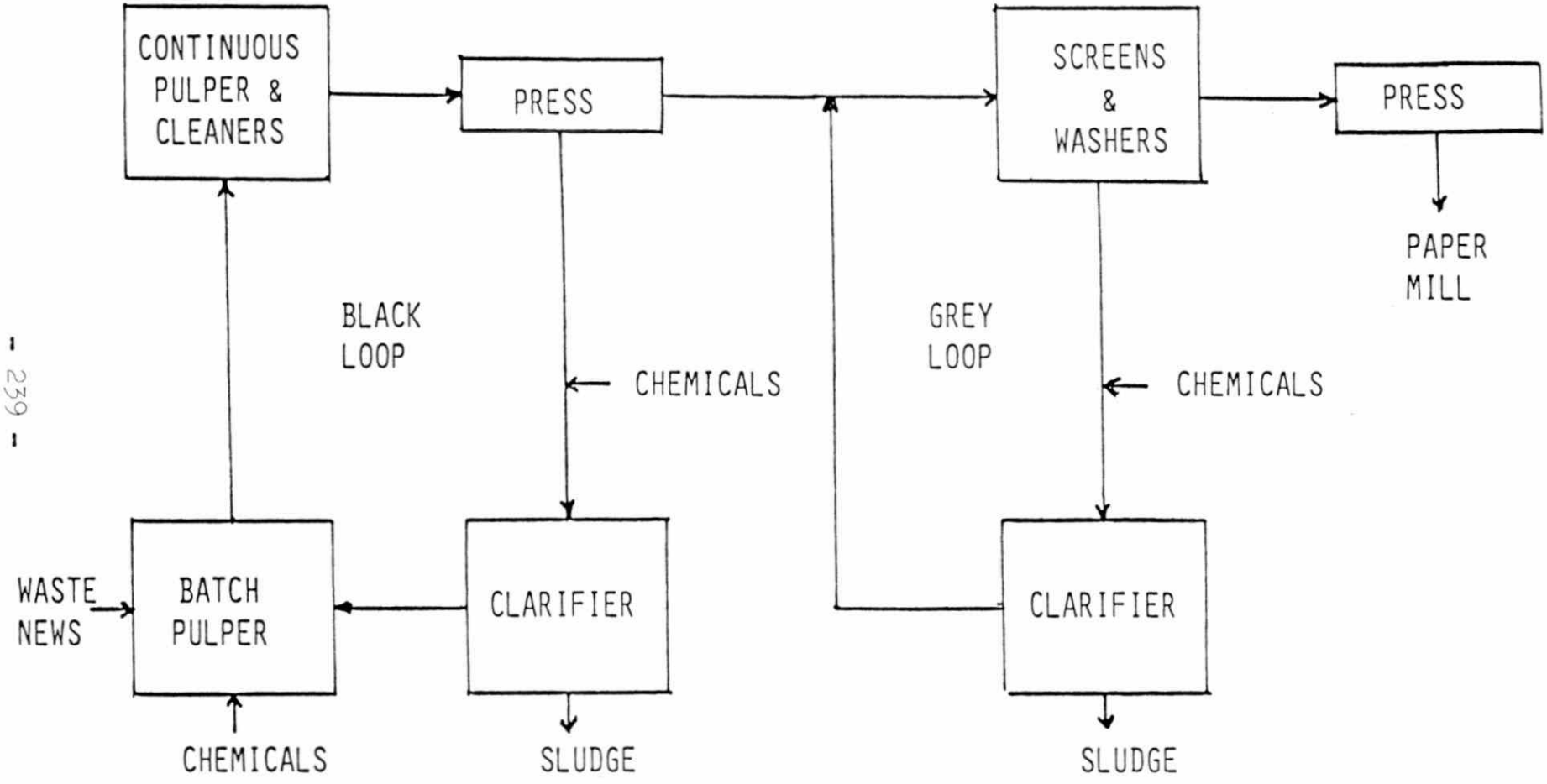
Secondary Treatment

The activated sludge process converts the non-settleable substances into a settleable biological floc consisting of bacteria, fungi, protozoa, etc. The conversion employs the organic material in the waste as food for these organisms. This is done in the presence of oxygen which is generated on site. In the UNOX system the area required for aeration is approximately one-sixth that for conventional activated sludge. The covered tank and high oxygen reduce the possibilities of odours in the neighborhood and give organisms with improved settleability. Nutrients in the form of phosphoric acid and liquid ammonia are added in the approximate ratio $BOD_5/N/P$ of 100/5/1. The materials are required for sludge propogation as paper wastes are deficient in these materials. The activated sludge is removed in two secondary clarifiers (125 ft. diameter) and largely recirculated back to the UNOX with fresh liquor. Some sludge is separated from the recycle stream, thickened and removed from the system.

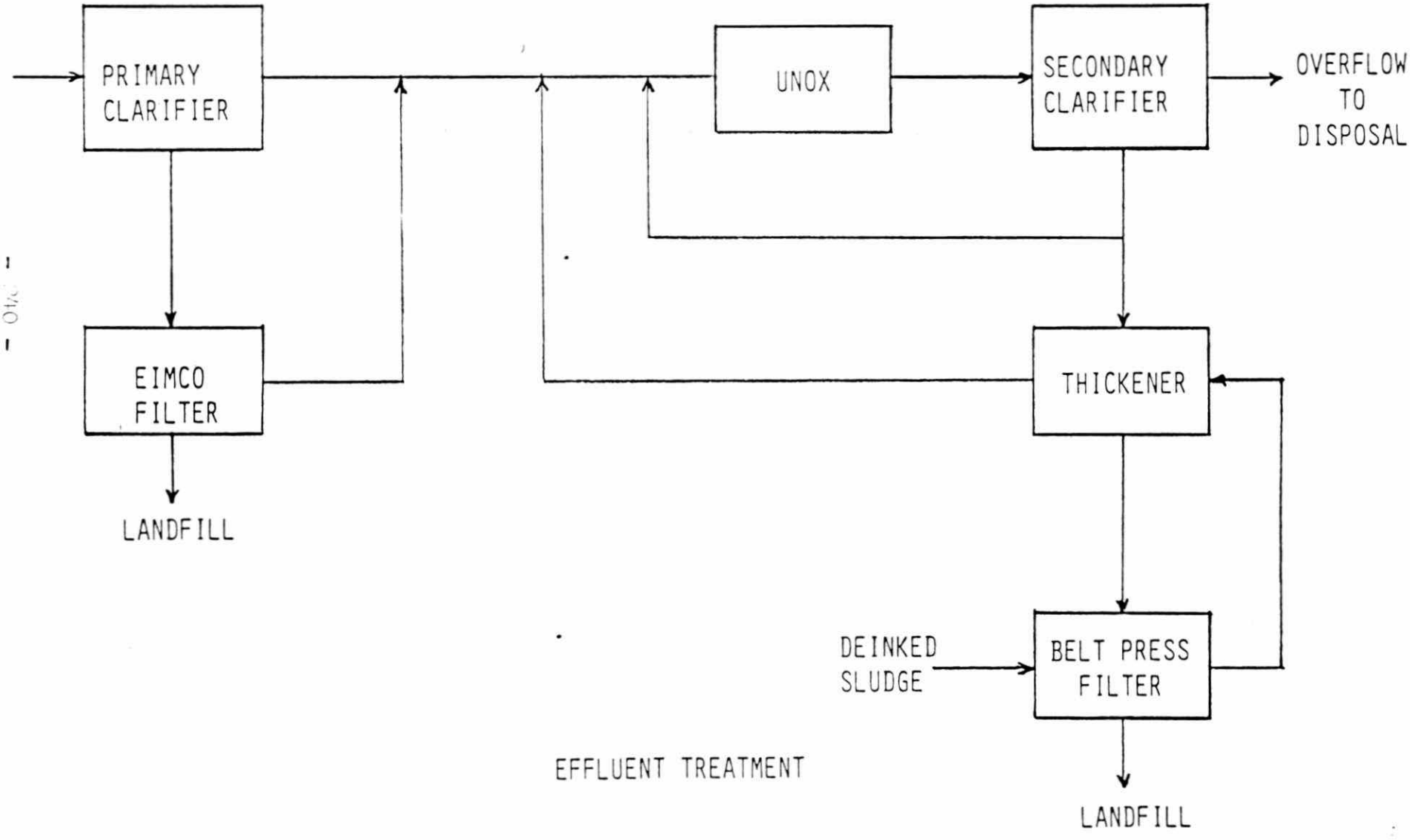
The combined deinked plant sludges are filtered on an Andritz Press Filter with or without activated sludge or some primary sludge and disposed of as landfill. Alternative uses for the sludge are being investigated. The filtrate is processed through the UNOX system before discharge from the mill.



THOROLD MILL RENOVATION



BELOIT DEINKING PROCESS



EFFLUENT TREATMENT

THE VERTICAL TUBE REACTOR

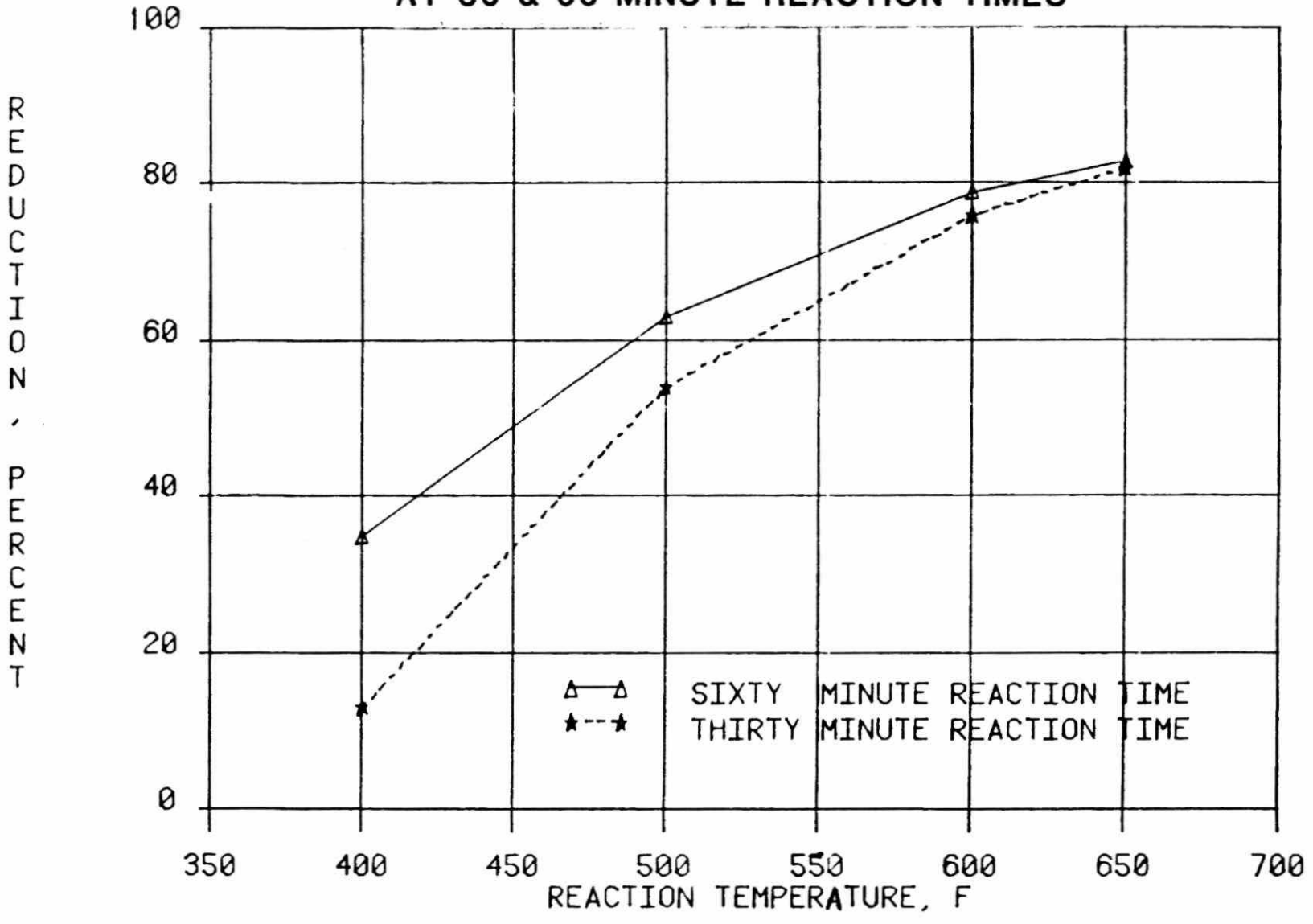
A WET AIR OXIDATION PROCESS

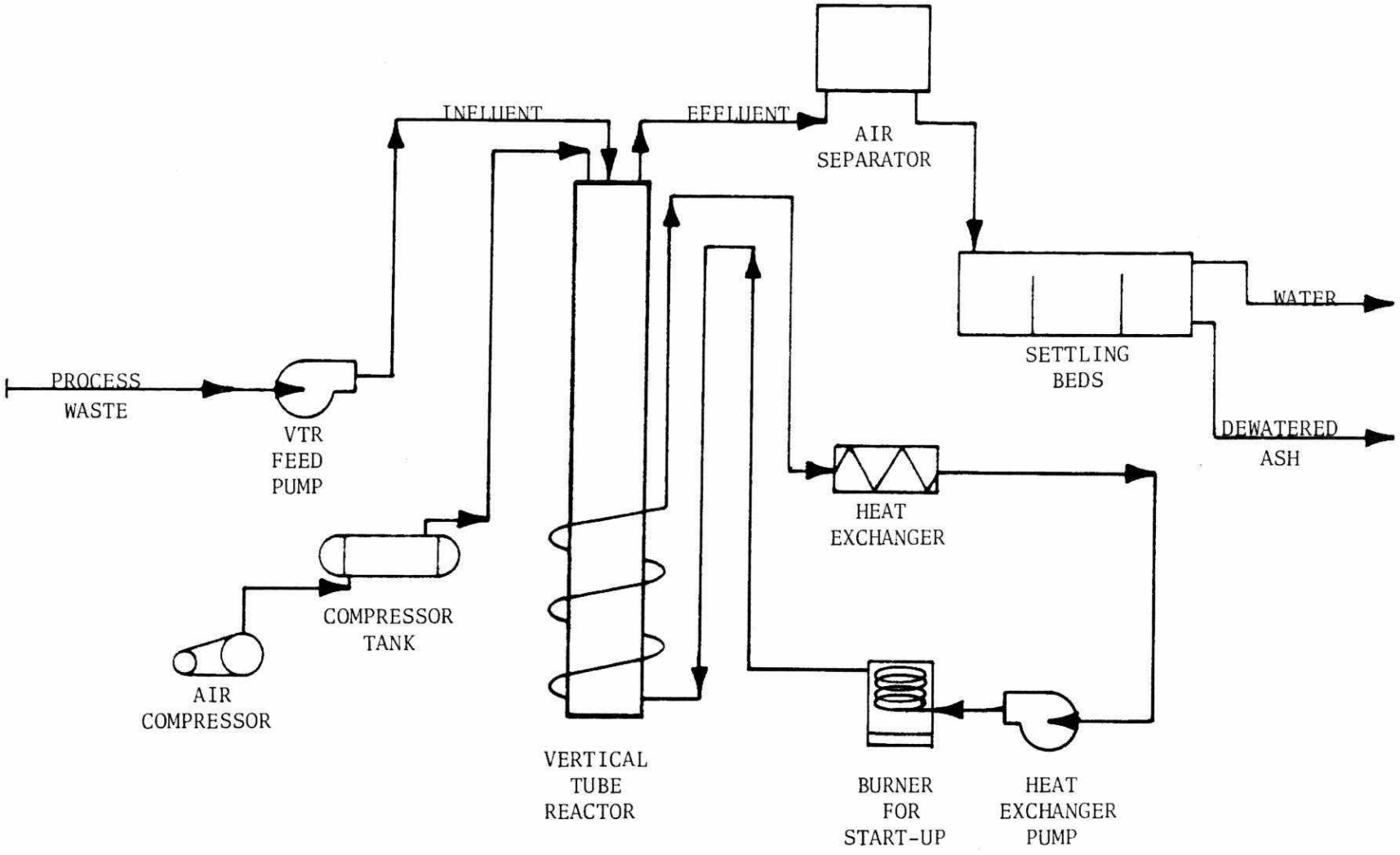
JAY L. MCGREW

AND

CHRISTINA B. CASSETTI

FIGURE 2. LBR COD RDXN DATA FOR DIGESTED SLUDGE AT 30 & 60 MINUTE REACTION TIMES





VERTICAL TUBE REACTOR PROCESS FLOW DIAGRAM

FIGURE 3

FIGURE 4. LONGMONT VTR OPERATION

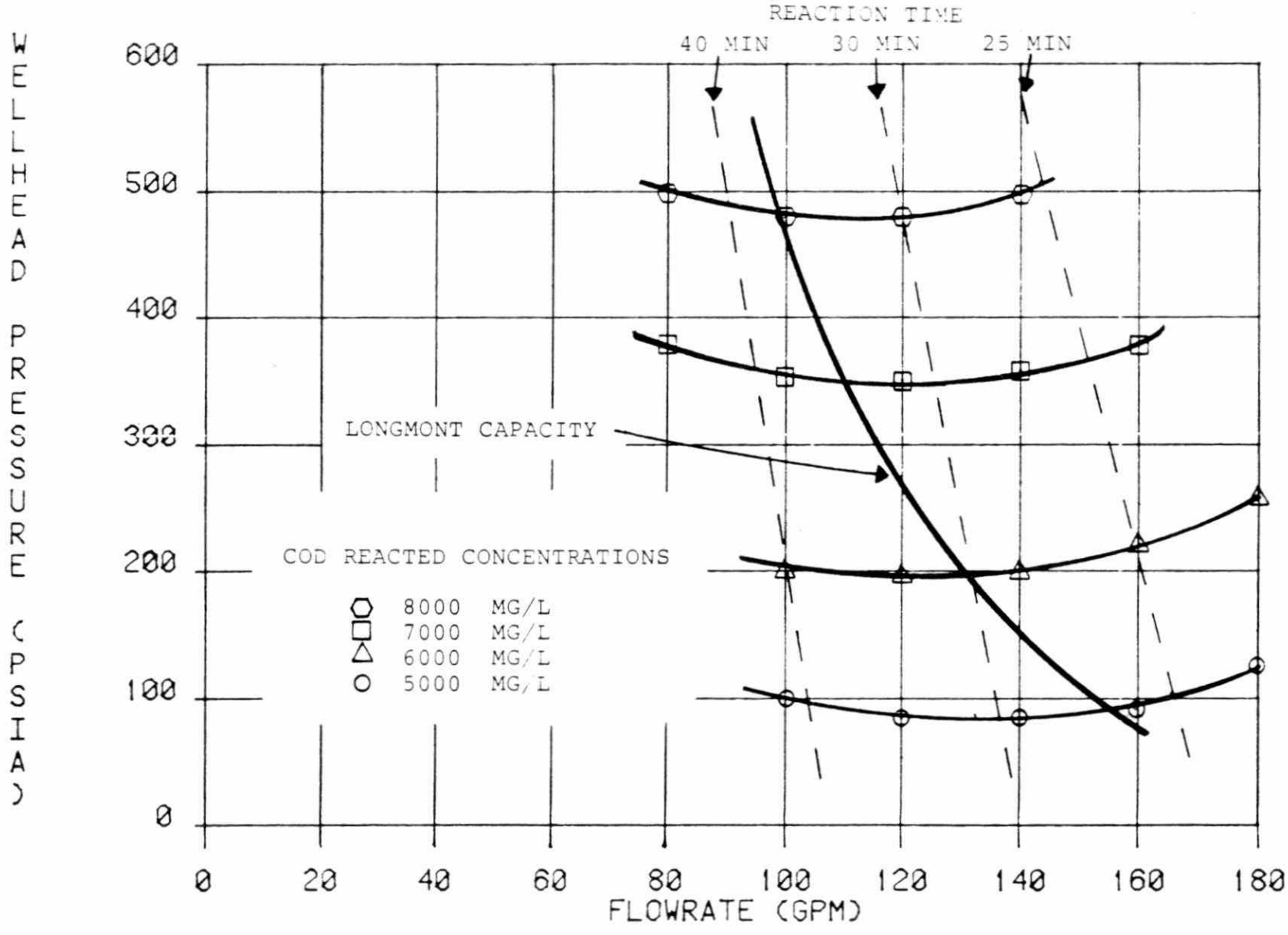


FIGURE 5. HEAT FLOW TO ROCK FROM VTR

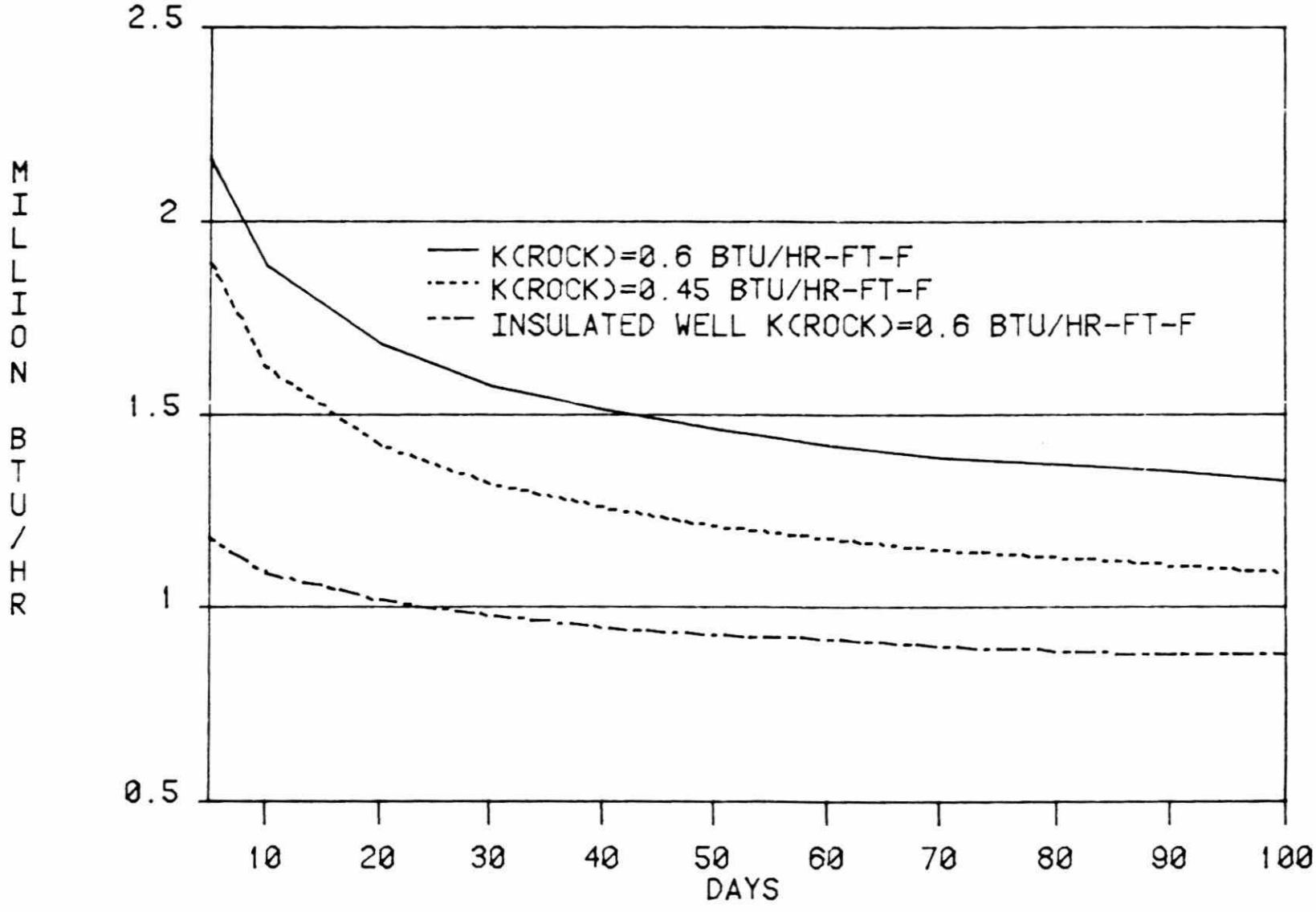


Figure 6 shows the general arrangement of the surface structure with the sludge storage tank to the left of the process equipment building and the reactor service derrick atop the control room on the right. In the process equipment room, Figure 7, the air compressor is on the left, and the sludge pump is in front of the sludge storage tank. In Figure 8, an interior view of the control room, the wellhead is in the foreground with the instrumentation and control panel in the rear. The effluent tank, as seen in Figure 9 is to the right of the sludge storage tank.

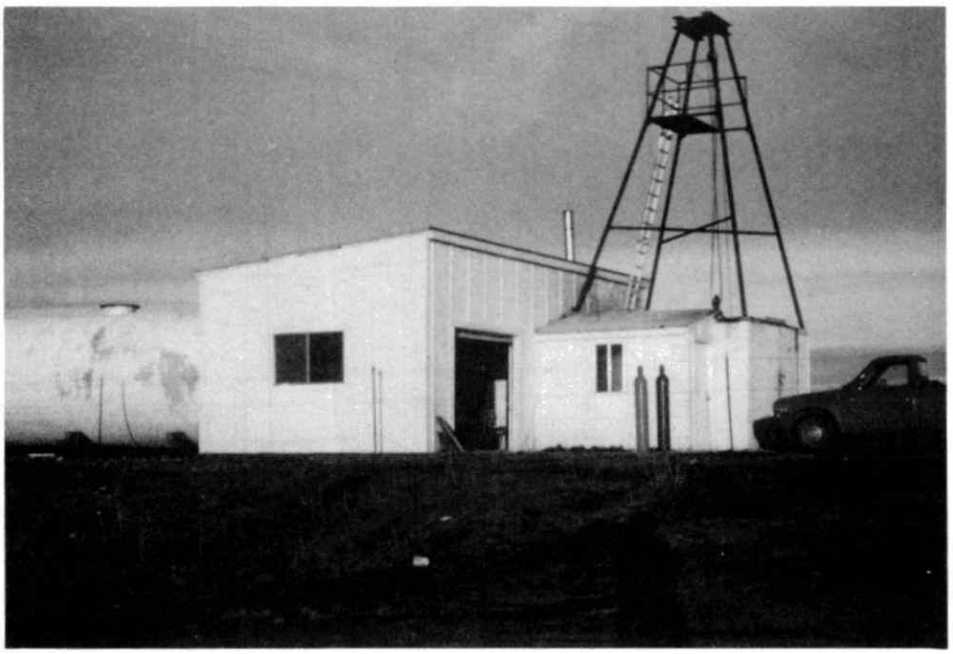


FIGURE 6. GENERAL ARRANGEMENT OF PPR FACILITY

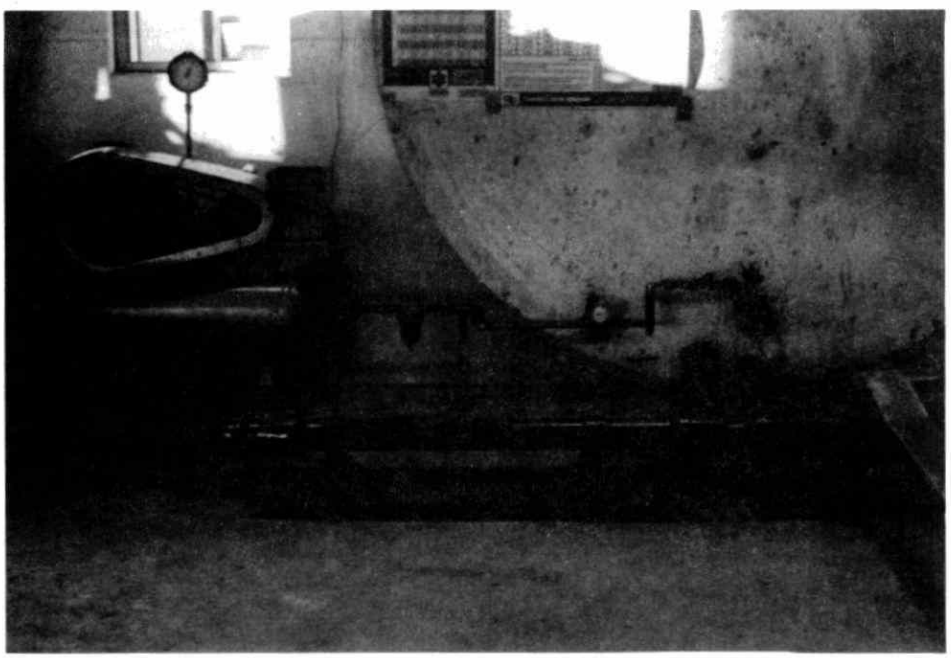


FIGURE 7. PPR EQUIPMENT ROOM, AIR COMPRESSOR

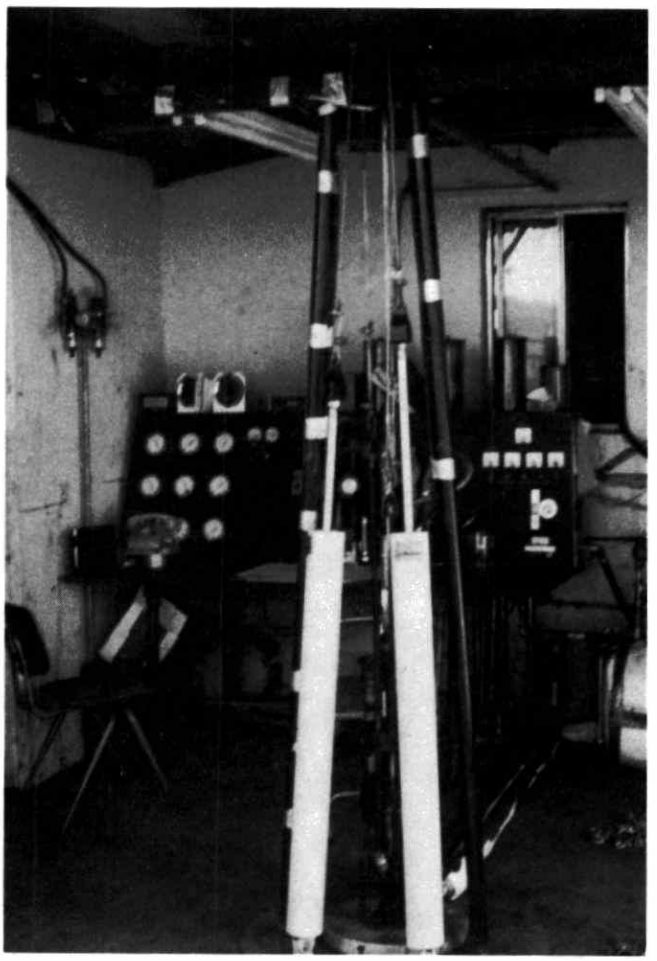


FIGURE 8. PPR CONTROL ROOM

FIGURE 9. EFFLUENT TANK IN THE PPR

Figures 10 and 11 show the LBR with a compressed gas cylinder. The 316L stainless steel tube is insulated in the casing in the right of Figure 11.

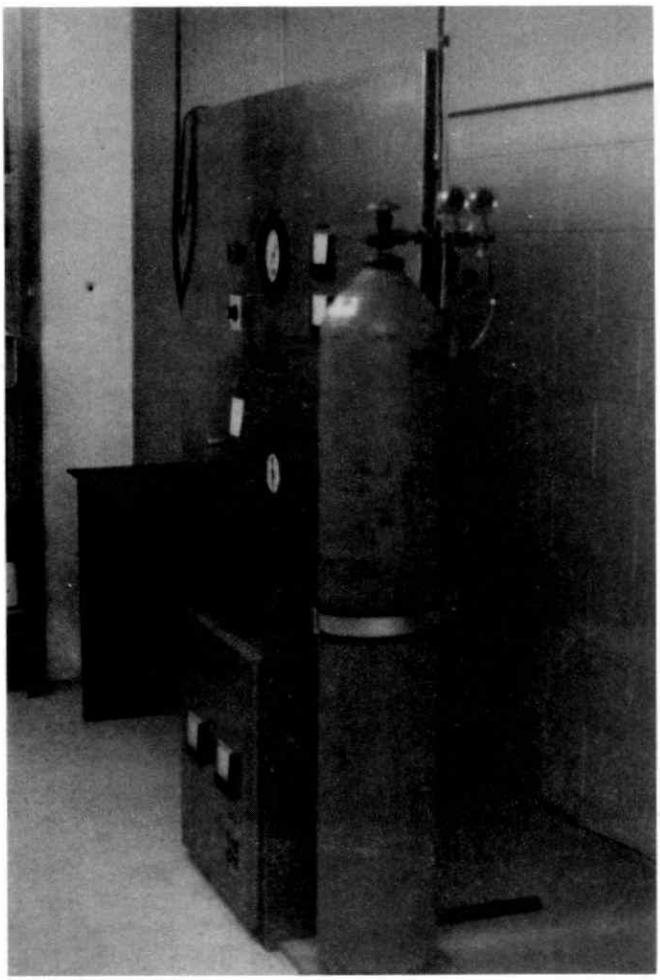


FIGURE 10. FRONT FACE OF LBR

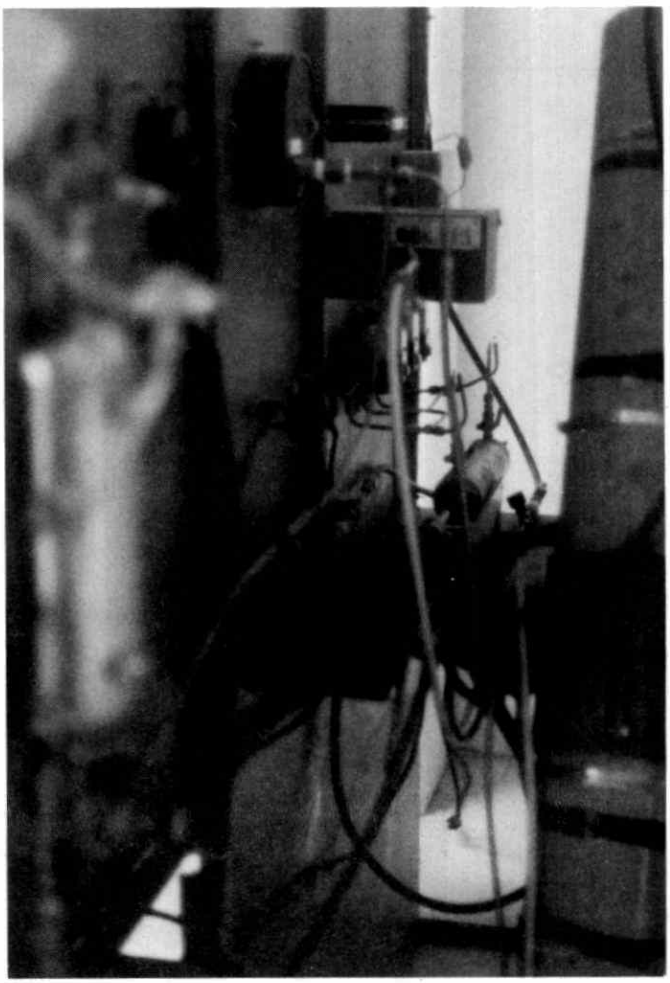


FIGURE 11. REAR OF LBR WITH OSCILLATING CONTROLS AND SAMPLE TUBING

Figures 12 and 13 demonstrate a thirty minute settleability test on Longmont Waste Water Treatment Plant sludge which had been treated with the LBR at the time and temperature conditions expected in the Longmont VTR.

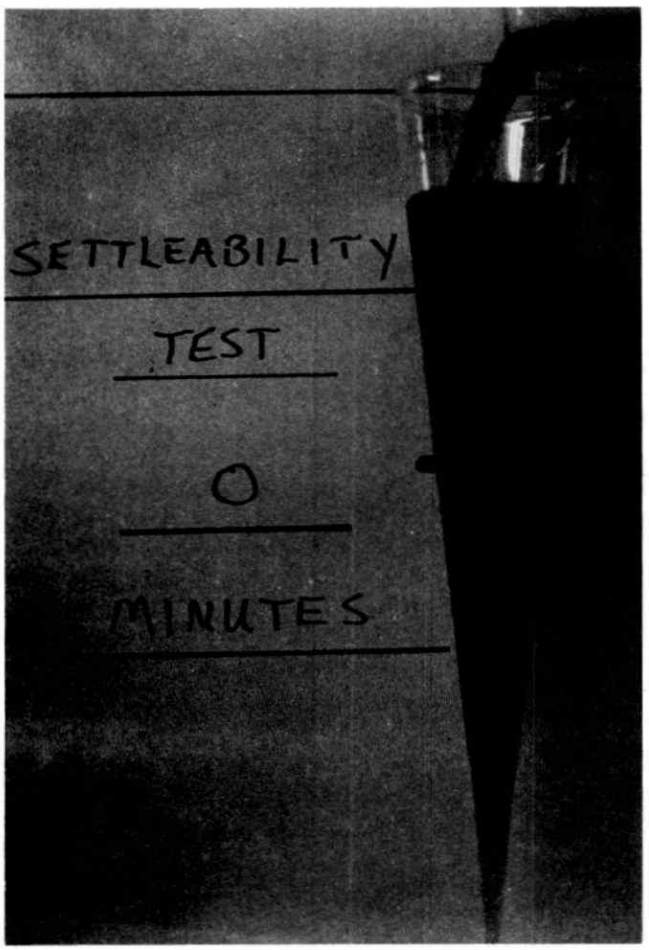


FIGURE 12. SETTLEABILITY TEST AT TIME ZERO ON LONGMONT W.W.T.P. SLUDGE TREATED WITH THE LBR

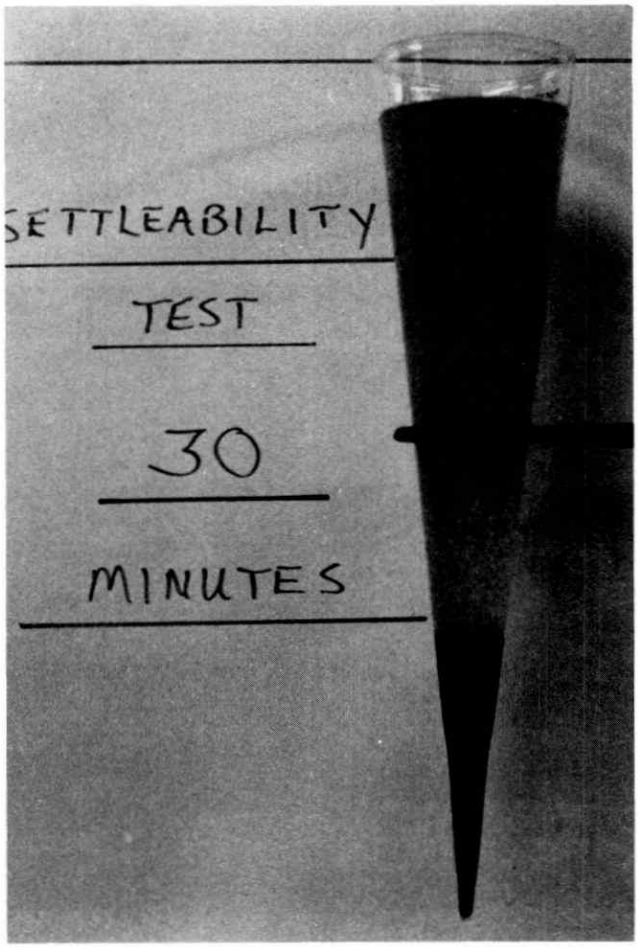


FIGURE 13. SETTLEABILITY TEST AFTER THIRTY MINUTES

A 3/4" = 1'0" scale model was constructed of the proposed Longmont VTR system. Figure 14 shows the process building. The air compressor and holding tanks are in the lower left. The downhole sludge pumps are shown in the lower center. The process control room and control panel in the top left are directly across the piping trench from the heat exchanger tank. At center right is the heat exchanger boiler tank for heating heat exchanger fluid before it is passed downhole. The nitric acid storage tank is shown in the lower right. Nitric acid and Tretolite 146 will be used to passivate the stainless steel and inhibit scale formation respectively. The effluent treatment system is shown at the top

right. At the far right tank the effluent will be degassed and then pass to the clarifier for separating the ash from the liquid.

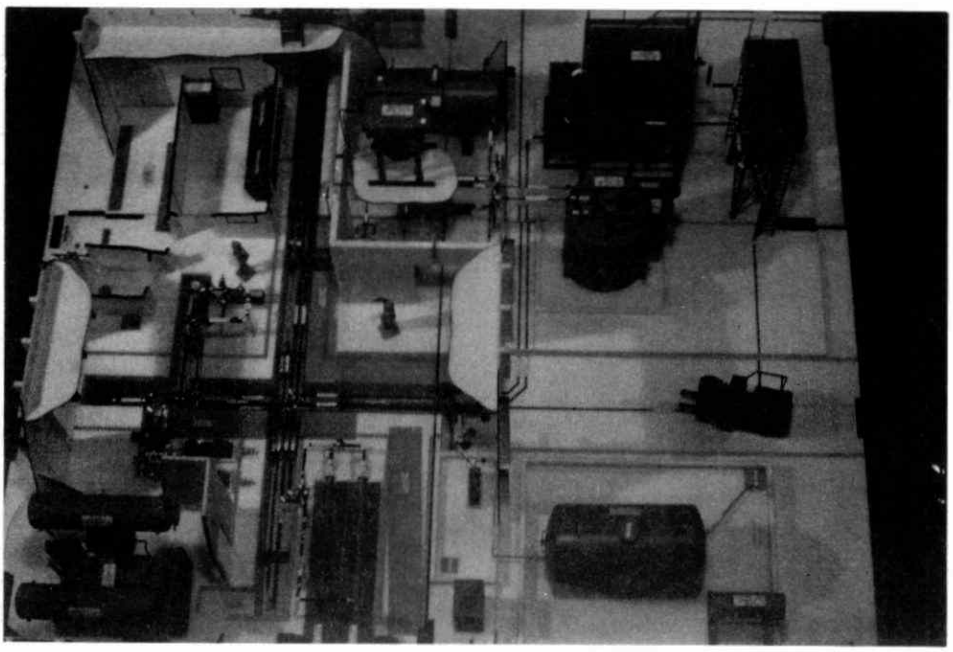


FIGURE 14. MODEL OF THE PROCESS BUILDING OF LONGMONT VTR

Figure 15 shows the model of the process building, (foreground) the downhole pipe handling system and (rear) the pipe preparation building.

Figures 16, 17 and 18 show the Longmont construction site. In Figure 16 the pipe preparation building is to the right and the process building is shown in the center. Figure 17 shows a piece of 10" pipe prior to being slipped downhole. Figure 18 shows the 10" pipe being slipped downhole.

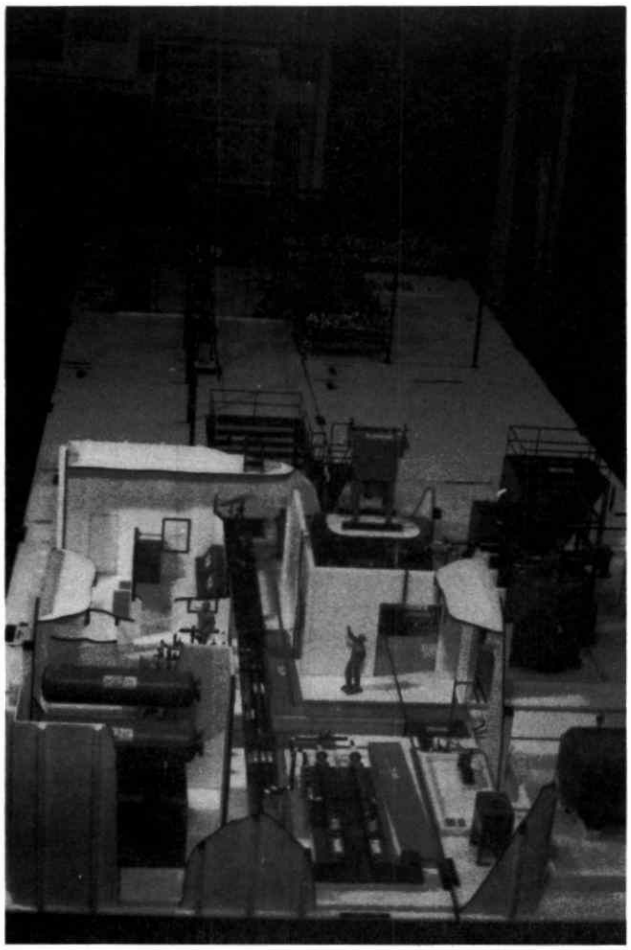


FIGURE 15. MODEL OF THE PROCESS BUILDING AND DOWNHOLE PIPE HANDLING SYSTEM OF LONGMONT & VTR

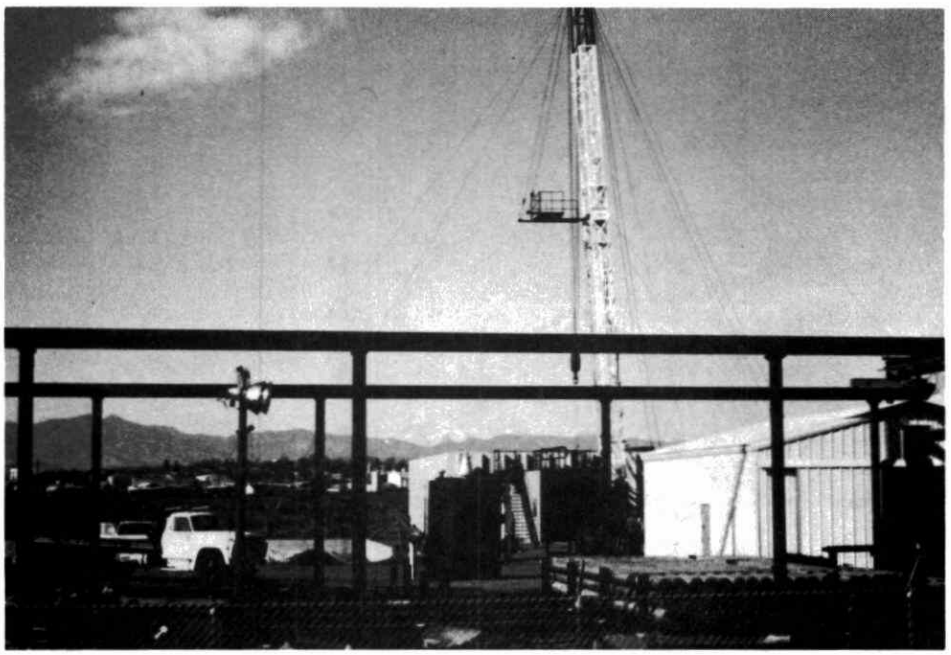


FIGURE 16. THE LONGMONT VTR CONSTRUCTION SITE

FIGURE 17. THE DOWNHOLE PIPE HANDLING SYSTEM AT THE LONGMONT VTR CONSTRUCTION SITE

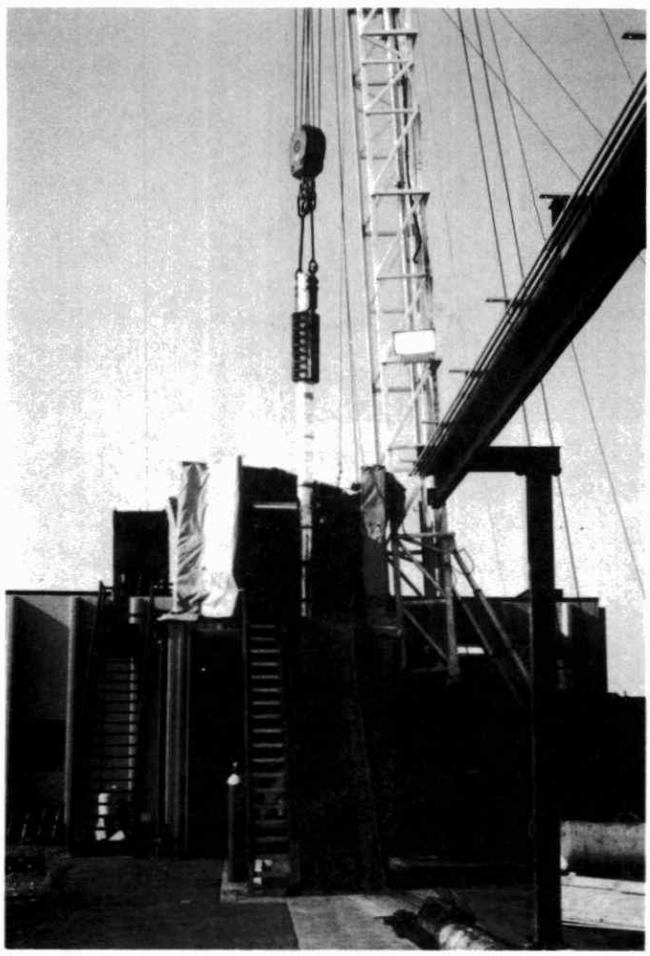
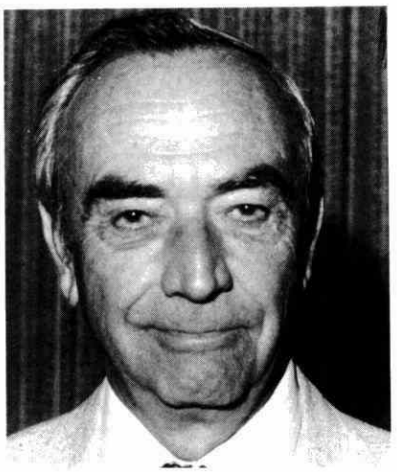


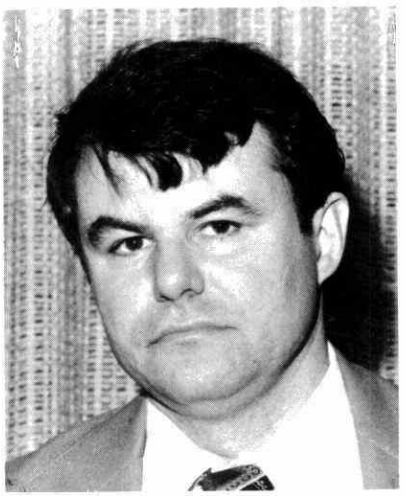
FIGURE 18. SLIPPING THE 10" PIPE DOWNHOLE AT LONGMONT CONSTRUCTION SITE

SESSION V—INDUSTRIAL POLLUTION CONTROL MANAGEMENT

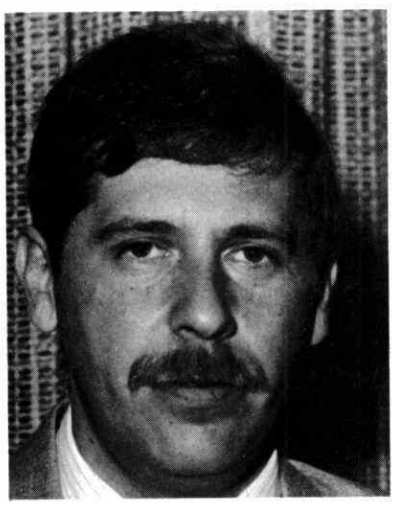


Chairman: R.E. Moore, Regional Director,
Southeastern Region, Ontario Ministry
of the Environment, Kingston, Ontario

B. Singh, Manager Industrial Abatement,
Central Region, Environment Ontario,
Don Mills, Ontario



S. Beszedits, Project Engineer,
The Proctor & Redfern Group,
Toronto, Ontario



P.S. Koehler, Senior Chemist,
Membrane Systems Division,
Zenon Environmental Inc.
Burlington, Ontario

R.M. Dick, Product Manager,
Simcool Equipment, Cincinnati
Milacron Marketing Company,
Cincinnati, Ohio

INDUSTRIAL ABATEMENT IN THE JUNCTION TRIANGLE

by

BARNEY SINGH
Manager, Industrial Abatement Section

Central Region
Ontario Ministry of the Environment

The Junction Triangle is an industrial/residential area of approximately 5,500 residents, in the northwest section of the City of Toronto. It derived its name from the confining triangular-shaped boundaries formed by railways and use of the term "junction" to describe places where converging railway tracks meet. The appropriately named Junction Triangle is sometimes called the Triangle by local residents. The area is shown on Maps 1 and 2.

The pollution problems of the neighbourhood have their origins in early land-use and in later changing demands of society for a cleaner and better environment. This paper is about pollution problems in the northern portion of the Triangle with Bloor Street as the southern boundary, and especially about the intensive pollution abatement programs after a significant chemical spill on April 6, 1982.

Early Development:

The Town of West Toronto Junction, a small farming community, at the cross-roads of Dundas and Keele Streets was a centre of early development west of the City of Toronto when rail lines were built parallel to the cross-roads. The intersection of the Grand Trunk Railway, the Toronto Grey and Bruce and the Credit Valley lines was aptly named the Junction, a name that survives to this day. In 1883, the three railways were purchased by the Canadian Pacific Railway (CPR) and a large repair shop and shunting yard located in the neighbourhood gave the area its industrial start.

Before the advent of modern communications, that is before the telephone and fast urban transportation, most of the CPR workers were required to live within one and a half miles of the yard in order to answer calls for crew work at short notice. Many of the homes in the area, small two-storey rowhouses, were built for these workers between 1884 and 1890. It is reported that two local entrepreneurs, in anticipation of the railway, had acquired the land and developed most of the housing.

At about this time in the late nineteenth century, manufacturing enterprises, employing organized production techniques were replacing craft-based industries. The latter supplied local needs while the former was geared towards the exploitation of larger markets which the railways made accessible. Access to the railways resulted in the establishment of several manufacturing industries and housing for the workers in the Junction area. The industries located alongside the tracks and housing filled the inner space. This symbiotic relationship of railway industry, and workers' residences is a dominant characteristic of industrial development of the period. A place to work and a nearby place to live satisfied the needs of the time. Unpleasant odour and dust were secondary to the needs of food and shelter.

In 1909 the Town of West Toronto Junction was annexed by the City of Toronto. This annexation provided the city with industrial land to meet its expansion needs and provided the Junction with finances for new sewers and the infrastructure for its burgeoning industries. The area continued to flourish and expand with an ever increasing number of new industries until the 1950's

Changing Development Status:

Since the 1950's roadways and road transportation have assumed increased importance for the transportation of raw materials and finished goods. The railways that were responsible for first attracting industry no longer played a significant role in servicing the industries; even industries with railway sidings on their properties, now use the services of the railway to a much lesser extent.

Improvements in public transportation and ownership of private automobiles have given workers greater mobile. The percentage of workers who now live and work in the local industries has been declining; development of new townhouse complexes within the Triangle has introduced residents whose birthplaces or workplaces are not in the Junction.

Changes in thinking and demands of the citizenry have had a pronounced influence on recent developments. The first zoning by-law passed by the City of Toronto in 1954 demonstrates that the mixing of industrial and residential areas was not considered desirable and would not be tolerated in the future. The killer smog in London in 1952 created world-wide attention to air pollution which was then characterized by the darkness of smoke issuing from stacks. Legislation in the 1960's, and enforcement by the Ministry and authorities that preceeded it, have resulted in signficant improvement in air quality as measured by our standard pollutants. City Council passed a zoning by-law on May 6, 1982 making three companies, Nacan, Glidden, and Viceroy, legal non-conforming users in the Triangle. Changes in the companies' operations which require building permits must now receive approval of the Committee of Adjustment.

It is a long held belief of the citizens that the industries deliberately discharge their industrial wastes into the sewers of the area; that the wastes are odorous and noxious, and escape into their homes and the neighbouring environment and cause them untold health problems. They also express concern about safety because of the storage and handling of hazardous materials and goods on plant premises which abut their residences. Although many improvements have been made to the management of pollution in the Triangle, a significant discharge of very odorous and noxious material took place into the sewer system on April 6, 1982.

Activities Prior to April 6, 1982

Abatement - The earliest efforts in environmental management were concentrated on the reduction of visible emissions of dust and

smoke and then on point sources of odours related to the various processing operations; however, these measures did not rid the neighbourhood of odour problems.

Several manufacturing companies in the Junction Triangle are in the paint and resin manufacturing business or employ paints and inks in their production processes. The raw materials, as well as the finished products, as anyone who has used a can of paint or varnish knows, are very odorous. Some raw materials have a very low odour threshold, i.e. extremely small quantities in very low concentrations are readily noticed and may cause discomfort and irritation of eyes and other tissues. Because these companies are near to each other, use similar materials and emit similar odours, and because they abut the residences, successful odour abatement has been achieved and with great difficulty.

Monitoring - The odours in the Junction Triangle and the effects of the chemical odours on health is of considerable concern to the citizens. The Ministry carried out an ambient air survey for contaminants in the Junction Triangle area in July and August 1980. The results are contained in Ministry report ARB-TDA Report No. 59-80 Ambient Air Survey in the Junction Triangle Area - Toronto, July-August 1980.

The Ministry's Mobile Air Monitoring (MAM) unit and Gas Chromatography (GC) were used. The survey established overall ambient air quality in the area and peak readings of specific hydrocarbons downwind of Glidden, Anchor Cap and Closure, and Nacan. The monitoring program was co-ordinated with production activities to ensure peak emissions and with a local wind tower to ensure correct downwind positioning of the unit. The table on page 4 is an extract of ground level concentrations (GLC) of various contaminants measured in the vicinity of the three plants.

Appendix A is the summary statement issued when the report was released. It is appropriate to quote the following extract dealing with environmental health

> "... at this time it is not possible to state whether minor decrements to health could result from long-term residence in such an environment, as smaller changes in health which might result over long periods of time would be difficult or impossible to distinguish from similar changes which accompany normal aging process. In light of present knowledge it appears that the nuisance of unpleasant odours and sporadic episodes of irritation of the eyes and other tissues may be the only significant effects. The more these can be controlled, the less likelihood there would be for the possibility of long term health effects."

In May 1981, a monitoring station which measures sulphur dioxide, coefficient of haze, carbon monoxide, nitrogen dioxide, oxides of nitrogen, ozone, total suspended particulate, and total hydrocarbons was installed at the Perth Public School which is in the heart of the area. The data from this station show comparable air quality with data from the Ministry's downtown station at 26 Breadalbane Street. The air quality in the Triangle can be said to

EXTRACTED DATA FROM AIR SAMPLING DATA REPORT
JULY-AUGUST 1980

CONTAMINANT	Ground Level Concentration (GLC) Geometric Mean ug/m³	Maximum ug/m³
Glidden - Number of Samples 66		
1,2,4 - Trimethyl benzene	40	231
1,3,5 - Trimethyl benzene	11	109
Total xylenes	196	1700
Ethyl benzene	35	374
Toluene	150	992
Methyl ethyl ketone	51	513
Decane		480
Isophorone		676
Anchor Cap - Number of Samples 63		
1,2,4 - Trimethyl benzene	81	516
1,3,5 - Trimethyl benzene	18	207
Total xylenes	69	384
Ethyl benzene	12	71
Toluene	36	174
Methyl ethyl ketone	36	86
Methyl butyl ketone	9	289
Nacan - Number of Samples 16		
1,2,4 - Trimethyl benzene	22	53
1,3,5 - Trimethyl benzene	6	33
Total xylenes	47	180
Toluene	82	225
Methyl ethyl ketone	42	738

be similar to the general air quality in Metropolitan Toronto. Figures 1 to 5 show a comparison of data from these two stations for the year 1982. The data from this station are transmitted on a real-time basis to the Ministry's computer data centre where abnormal exceedances will trigger immediate attention.

School Absenteeism

A frequently voiced concern is the effect of pollution on the health of children in the area. The perception and expressed opinions of some primary school teachers are that there is greater absenteeism; observance of various types of illnesses that may be symtomatic of chemical pollution; and the fear that pupils may be suffering from various forms of learning disabilities.

As a result of these concerns, a comparative study of absenteeism of 32 schools from all areas of the City of Toronto was undertaken from records for the period 1975 to 1980. Extracts from this report, A Statistical Assessment of Comparative Absenteeism in the Primary Schools of the City of Toronto by Philip Miller, Ph.D. are quoted to show the extremely difficult task of confirming the perceptions and concerns of the teachers. On page 1, the author explains that the report directs itself to whether there are differences in absenteeism between schools but that the reasons for absenteeism are beyond the scope of the study.

> "It is the first question, of whether there are significant differences in absenteeism between schools to which the study principally directs itself. The second question, of reasons for absenteeism may be of interest to educational administration, but this objective is of secondary interest and largely beyond the scope of this study." Page 1.

The study found that the Perth School, which is in the heart of the Triangle, has a mean absenteeism of .060 compared to the Toronto average of .051 but there are enough socio-economic variables, such as population density, that make it impossible to attribute this difference to chemical pollution. When we consider the statement "no group test refuted the hypothesis that air pollution may be implicated" we find ourselves faced with the impossible task of proving the negative; we cannot prove that air pollution in the Triangle does not have an effect on health.

The following quotations from page 47 illustrate that this report raised more questions than the single answer it provided.

> "Socio-economic differences were also found to be significant in relation to absenteeism..." "In combination, population density was the most significant factor." "The hypothesis of environmental pollution effects is not disproved and can be considered as a viable hypothesis for the unexplained differences."

From page 49, we get the following statement

> "More information is needed on the type of illness (sic) and on their magnitude in school absences. As well, more information is needed from the health sciences on morbidity and air pollution".

I have described the above activities of abatement, monitoring and the study of school absenteeism to illustrate the level of attention given to the Junction Triangle for some time now. I will now go on to describe the discharge of April 6, 1982 and the intensification of activities that followed.

Significant Complaint Investigations

The Ministry responded to 196 complaints since April 6, 1982. The most significant ones since that date are discussed below.

The April 6, 1982 Discharge

The event manifested itself in odorous fumes from area sewers in the early hours of April 6, 1982; the fumes entered some homes through the sewer; it caused seven persons to be taken to hospital; area streets were closed to traffic; sewers were flushed by the Fire Department; area schools were closed; underground tanks were excavated and examined for leaks; plant records were examined and plant staff were interviewed and interrogated; staff from the wet well area of the Metro sewage treatment plant were evacuated; opposition demands were made in the legislature for action and clean-up; media and citizens made demands for information on the spilled chemicals and its source, and demanded swift and strong action against the perpetrators.

Ministry staff were convinced that the cause was not a leaking tank but a large single discharge. Working around the clock, staff were gradually zeroing on prime candidates. These efforts bore fruit on April 16, 1982 with the following press release by Mr. John Shepherd of the Nacan Company

> "I have indications last night, which were confirmed this morning, concerning this company's responsibilities for the April 5 chemical spill into the Toronto sewer system. On receipt of the first indication, I passed the information onto the Ministry of the Environment who had been conducting the investigation. Contrary to earlier information, it now appears that between 800 and 900 gallons of a mixture containing mainly butyl acrylate and vinyl acetate were sewered by one of our employees in a misguided attempt to rectify his operating error. He did not refer the matter to his supervisor who would have prevented his action. A number of details remain yet to be established and that investigation is continuing. On behalf of the company, I wish to make an immediate apology to the many people who were affected by this

discharge and particularly such an occurrence could have taken place because I believe over the years this company has been a good neighbour and has not polluted the environment. I'll answer any questions."

The company was charged for violation of the Environmental Protection Act, and was found guilty and fined in November 1982.

The Aftermath of April 6, 1982

The people, the press and the politicians called for the most stringent actions to prevent similar incidents. The Ministry took the lead role in getting all agencies with jurisdiction to formulate action plans for those companies considered to be potential chemical polluters. The companies identified were Glidden, Nacan, Inmont, Anchor Cap and Closure, Viceroy, and Canadian General Electric.

A word about jurisdictional responsibilities; the sewers in the Triangle are the property of the City of Toronto; in order to ensure uniform effluent standards throughout Metropolitan Toronto, the sewer-use by-law, which set contaminant concentrations, is under the jurisdiction of Metro Toronto; the Ministry of the Environment's jurisdiction applies to emissions and discharges to the natural environment. Working together as a team, the operations of the candidate companies were reviewed and needed works, including interceptors, product separation tanks, alarm systems, batch discharging, sampling before discharge, and log keeping; were identified for implementation as scheduled programs.

The Ministry, acting on its own, reviewed the processing operations of the companies to identify further abatement action on sources of air emission. Staff found general receptivity and willingness on the part of most companies to undertake works for improved pollution management. Pressure was mounting for companies to clean up, or get out.

The June 18, 1982 Emission

In the early hours of the morning of June 18, 1982, the Fire Department, police, the Ministry, City and Metro Works staff responded to a complaint of a foul odour in the air. The odour was considered significant and persisted for about one and a half hours. It resulted in two persons seeking medical attention at hospital. The odour was considered to be caused by an air emission and not a sewer discharge. The event was reported in the media as another chemical spill and gave the impression that once again a company had dumped another load of chemicals down the sewers.

In our investigations for the source of this emission, we discovered that the night of June 17, 1982, was an eventful one, in which four separate incidents had occurred.

1. Between 8:00 and 9:00 p.m. of June 17, 1983, the Fire Department and the City of Toronto Hazard Department responded to an odour complaint at 80 Franklin Avenue. The sewers were checked but odours were considered to be caused by an air emission. Although a possible source was identified, the evidence could not satisfy legal requirements for a successful prosecution.

2. The Nacan Company lost approximately 500 gallons of non-odorous product, a water base household glue, to the sewer because of a broken hose. There was no odorous emission or discharge to the environment and the discharge to the sewer met the effluent discharge standard.

3. The source of the high intensity odour of June 18 between the hours of 4:00 and 5:30 a.m. was not identified; the type of odour was characterized by several knowledgeable persons and while we suspected sources we were unable to establish them with certainty.

4. On June 17, the Inmont Company experienced a process upset between 9:35 and 11:30 p.m., there was no discharge to the sewer system as the material solidifies on contact with water; there were no complaints of odours from this incident. This upset was an unlikely cause of the early morning complaint as the odour characteristics would have been different and because of the time lapse, severity and short duration.

The headlines of another spill and revelation of four incidents in one evening, fanned the flames of impending tragedy for this neighbourhood. Although only one incident, the emission in the early hours of June 18 was of any environmental significance, there were loud demands for strong and immediate action to prevent these many incidents.

Air Emission, June 24, 1982

At the conclusion of a public meeting on June 24, at the St. Luigi's Separate School, the neighbourhood was experiencing one of its odour episodes. A chemical odour prevaded certain sections of the area and afforded the citizens and the many officials present an opportunity to exprience, together, an actual odour incident. The Fire Department arrived at the scene while the neighbourhood was being surveyed to isolate the likely source of the odour. They had responded to a complaint of a spill in the Junction Triangle. The sewers were checked and there was agreement between the Fire Department and ourselves that no odours were coming from the sewers but that the odour was caused by an air emission from a building of an operating industry. An hour later another fire engine from another station arrived at the scene in answer to a similar complaint of a spill in the area. This explains the often repeated perception of citizens about frequent spills to the sewers in the Junction Triangle - fire engines race through the streets, staff check sewers, and in some cases flush them without evidence that something needed flushing.

Ministry investigations resulted in the laying of charges against the Glidden Company. The company was found guilty on May 5, 1983, under Section 13 of the Environmental Protection Act, for emitting a contaminant causing material discomfort. A similar charge against this company for an incident on July 12, 1982 was dismissed.

April 8, 1983 Discharge

On the evening of April 8, 1983, as if to celebrate the event of the previous year, a spill was reported at the Glidden plant. The plant was on strike and at about 10:00 p.m. guards found valves of two tanks fully open. The tanks contained a finished product that is used for coating the insides of pop cans. The guards closed the valves and called the Fire Department. The alert program of notifying others was instituted. By use of absorbent material, and contingency equipment, the Fire Department and company staff were able to contain the flow which was entering a yard drain. The material was cleaned up; solid wastes were taken to a secure landfill site the following morning and the liquid waste was trucked by the company's licenced hauler. It was estimated that about 50 to 100 gallons of spilled product entered the sewer system through the yard drain.

Sabotage by unknown persons is suspected. There were no complaints of noxious fumes by residents of the area; the area sewers were checked and no strong odours or fumes were detected in the neighbourhood.

May 31, 1983 Discharge

A complaint about odours from the sewer system on May 31, 1983 was investigated. It was found that the discharge from the reactor scrubber of Inmont was causing the odour problem. The company's operation was modified and a discharge of an acceptable contaminant level was achieved. The company is required to improve the performance of this system under the Program Approval that was issued on March 31, 1983.

Ministry Action Program

The Honourable Keith Norton, Minister of the Environment issued a news release on July 16, 1982.

ENVIRONMENT MINISTER NORTON ORDERS
SPECIAL ACTION PROGRAM
TO STOP POLLUTION BY JUNCTION TRIANGLE COMPANIES

Environment Minister Keith C. Norton has ordered an accelerated Action Program to end environmental mishaps at manufacturing companies in Toronto's Junction Triangle Area.

Mr. Norton said today his Ministry has launched a three-pronged program to protect the residents from pollution resulting from manufacturing operations of companies in the Junction.

Already on the way is an intensive investigation by Environment Ontario technical staff to establish pollution control programs and effective abatement measures to be undertaken by the companies.

Ministry orders will require control measures and establish deadlines for the progressive completion of the programs required to protect residents from noxious discharges or emissions.

Existing environmental legislation will be amended to provide the Ministry with improved capability to ensure delivery of effective abatement programs in the Junction Triangle and elsewhere in Ontario. This will include provisions to protect employees who may report unacceptable environmental practices by their employers; a provision to ensure that once in place control programs will be finally firm and enforceable, and measures to require companies to carry out monitoring programs and to have personnel in place to prevent pollution.

"I have ordered Ministry staff to accelerate efforts on these programs and to prepare any legal steps required to end what seems to be a continuing series of environmental accidents resulting from the operations of the manufacturing companies in the Junction Triangle", said Mr. Norton.

"Ministry staff is currently working with the companies to pinpoint programs, control orders will be introduced at public meetings, and then adopted to ensure these programs are undertaken and completed by the companies. In addition, I am prepared to introduce amendment to our legislation this Autumn to provide improved capability to address these problems."

Residents will be invited to participate in meetings to consider control order, Mr. Norton emphasized. The Ministry has already asked residents to report unusual environmental incidents, spills or emissions to the Ministry's Regional Office in Don Mills at 424-3000 on a 24-hour basis.

The Ministry has completed an intensive three-week investigation of two unrelated incidents which occurred on June 17 and 18, the evidence is considered insufficient to support legal charges.

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I have ordered staff to keep the file open and to continue monitoring in that area to ensure that operating practices of certain companies are improved to lessen the chance of such odour incidents occurring.

The Ministry of the Environment also is participating in the Toronto Action Task Force which formed to define method of reducing the threat of discharges or emissions in the area."

Two of the three-pronged programs have been implemented. A legislation package, ready for presentation in the Fall session of the legislature, is now planned for introduction during the present Spring session.

Mayor's Action Task Force

The Executive Council of the City of Toronto responded to the early incidents by establishing an Action Task Force under the chairmanship of the Mayor, Mr. Art Eggleton. The Task Force was composed of Provincial, City and Metro officials and the two Ward Aldermen of the area.

The Task Force consulted with citizens and industry representatives and developed an Alert Plan which is reproduced as Appendix B. The Alert Plan was printed in four languages and was distributed to residents in the neighbourhood.

The Alert Plan is not a revolutionary document. It states, and makes available to a wide audience, the practices observed by staff in the operating agencies. More people were made aware of how to seek service, and of the roles of the various agencies. For some, it cleared the jurisdictional jungle that existed in their minds. Another positive aspect of the Task Force was that, at last, citizens felt that they had caught the attention of City Hall, and of the Provincial government, and of those bureaucrats who are responsible for solving their problems.

Public Participation

Public Meeting - June 24, 1982 - The April discharge and the June 18 incidents moved the citizens to hold a public meeting at the St. Luigi's Separate Primary School on June 24, 1982. Officials of the Ministries of Labour and Environment and of the City and Metro Departments were invited to speak on the recent incidents of April 6 and June 18 and to explain their roles and responsibilities for pollution abatement in the area. As no one agency has complete and overall responsibility for resolving the pollution problems of the area, the information presented was used by the organizers to propagate the idea that the government officials were all confused about their roles and responsibilities, and as a result it would be impossible to find solutions for the problems; the citizens were unfortunate victims of this confusion. The truth was that the officials were clear about their roles and responsibilities, but the public was not. Unfortunately, this transference of fault (attributing the confusion to the wrong party) results in the clouding of issues, interferes with understanding the true nature of problems and makes solutions difficult.

The residents took the opportunity to express their fears and anxieties, and to state their disappointment about the lack of concern by the companies and government officials. The Ministry of the Environment was severely criticized for lack of action in past years. It was obvious that a calmer forum was required for

discussion of problems and the formulation of solutions. I suggested the establishment of an Environmental Liaison Committee with representatives of the citizens, the companies and involved government officers meeting at regular intervals.

At the conclusion of the meeting, the residents established a Watchdog Committee Against Pollution with the specific purpose of applying pressure on the companies and the government to clean up the Junction Triangle. The Watchdog Committee is one of two citizens group with whom the Ministry works. The other is the Junction Triangle Anti-Pollution Group which was established for the a similar purpose in 1974.

At the conclusion of the public meeting it was found that the neighbourhood was experiencing one of its odour episodes. It was discussed in an earlier section.

Public Meeting July 27, 1982 - The Mayor's Action Task Force held a public meeting of residents to hear from the citizens and to present an interim report on its activities. The citizens reiterated their problems and expressed disappointment about the lack of action. Many expressed the view that the problem industries should be removed from the area.

Public Meeting September 30, 1982 - The Watchdog Committee sponsored a forum on pollution with guest speakers who spoke on various aspects of health and environmental pollution. Most of the concerns mentioned at the two previous meetings were again raised. The Ministry reported on the various abatement programs that were being instituted. It was made quite clear that because of the tight land use and the nature of some industries that the neighbourhood would never be free of odours but that these would be kept to as low an intensity and frequency as is practical.

Public Meeting January 12, 1983 - The Ministry of the Environment held a public meeting to discuss draft documents for a Control Order for the Glidden Company and Program Approvals for Nacan and Inmont. This was preceeded by a meeting with the executive of the Watchdog Committee and an offer to have a meeting with the executive of the Anti-Pollution Group. An open-house was held on January 26, 1983 for citizens to seek clarification of details or to make suggestions and changes to the documents.

Meeting with School Teachers - May 3, 1983

Ministry staff met with the teachers of three primary schools of the Separate School Board and explained the various abatement pollution control measures that are in place. Monitoring results of air quality were discussed and the medical opinion on health effects provided to the Ministry was presented. The proposed health study was discussed by a representative of the City of Toronto Department of Health. Because of their insistence of greater illness and absenteeism among the pupils, the teachers were advised to seek the development of a program to document their observations so that there could be reliable data to substantiate their perceptions.

All of the above meetings served to develop a better understanding of the problems of the area; to inform citizens of developments, and to seek their input, involvement and participation in what is happening.

The Ministry Complaint Response System

The Central Region of the Ministry maintains an emergency response system with 26 staff members (Duty Officers), each on a one week duty period for after-hours complaints. It is organized to deal with emergencies, i.e., spills and accidents which require prompt action to minimize environmental damage. On receipt of an emergency call, appropriate Ministry district staff is contacted and respond to the emergency. Although it is not a stand-by system, the Region has always been able to get appropriate staff to respond in emergencies. The commercial answering service which is used after-hours will normally only pass on complaints of odour (other than from spills and accidents) if the problem is widespread, i.e. there are three calls about the same complaint. Non-emergency calls are dealt with routinely by the district staff on the next working day.

The Junction Triangle was given the status of a priority complaint area which meant that all complaints from the Triangle were to be investigated without delay. This has severely taxed the resources of staff and it is hoped that once all abatement measures are in place, this special status will no longer be necessary.

The complaint history since April 6, 1982, has brought to light some interesting facts. With one exception, none of the 196 complaints investigated was from discharges of odorous materials to the sewer system; complaints have been related to air-borne emissions and do not support statements of frequent industrial dumping of wastes into the sewers. In one case the Ministry responded to odour emanating from a tar pot used for roofing repair; and in another the complaint was traced to lacquer being applied to a balcony. These two incidents were used to explain to the citizens that an odour free environment is not an achievable expectation. Normal housekeeping activities by citizens generate odours and their industrial neighbours will also do so from time to time. It is the duty of the Ministry and the industries to ensure that these emissions are kept at low levels and are avoided whenever possible.

The Alert response system for the Junction Triangle relies heavily on the services of the Local Fire Halls which are staffed on a 24-hour basis. Every complaint is no longer called a spill, and a fire engine prepared for flushing the sewers no longer responds routinely to such calls. Fire Department staff, in a department car, now respond to many calls; this is less disturbing to the neighbourhood and puts a better perspective on the problems. The working level relationship between the Ministry and the Fire Department is excellent and our feedback to complainants is developing better understanding of the nautre of problems within the Triangle area. Residents appear to be pleased when we are able to identify the odour source outside the Triangle.

Health Study

At the public meetings, the representatives of the Health Department could not assure citizens that the low concentrations of chemical pollution were not injurious to their health in the long run, or to comment on whether their many ailments were caused by the quality of the environment. As health is a major concern of the citizens, Minister Norton announced that the Province of Ontario will fund half the cost of a health study on the effects of pollution in the Junction Triangle. The study is being done by a recognized consultant supported by experienced staff under the direction of the Medical Officer of Health of the City of Toronto. It will compare health of citizens within the Junction Triangle with that of citizens in other areas of the city. A public meeting for citizen input before the study commences was held on June 9, 1983. A Community Advisory Group, comprises citizen representatives makes recommendations and provides liaison between the study team and the community.

ABATEMENT PROGRAMS

As mentioned earlier, pollution abatement in the Junction Triangle was an ongoing operation but after the April 6, 1982 incident activities were intensified on six companies with the potential for odour problems. The abatement programs of these six companies are described below:

Anchor Cap and Closure, Wallace Avenue

Anchor Cap manufactures lids and caps for containers at 275 Wallace Avenue. The various operations use paints and inks and cause odours which result in loss of enjoyment and normal use of property, and material discomfort to citizens. In 1969, the Ministry ordered Anchor Cap to install an incinerator as a positive means of odour control. Anchor Cap appealed this Order to the Environmental Appeal Board and proposed an elevated stack which the Board authorized.

The odour problem was not solved and in 1977 the Ministry issued a new Order for an incinerator. This Order was amended to allow Anchor Cap to study and report on low solvent coatings as an alternative to incineration; however, if the low solvent coatings were not viable the incinerator was to be installed in 1979.

In 1979, Anchor Cap requested a further amendment to the Order. They proposed a 30-metre high stack in place of the incinerator. The Director refused the amendment on the ground that the proposed solution would be ineffective. Anchor Cap obtained a ruling from the Divisional Court that the company had the right to appeal refusals, as a refusal is tantamount to a new Order, and Orders are appealable. A proposed legislative change would make such refusals unappealable.

In November 1980, the Environmental Appeal Board ordered the Ministry to issue a Certificate of Approval for a 30-metre stack. This Order was subsequently amended at the request of Anchor Cap to permit two 30-metre high stacks. Installation was to be completed by May 1, 1982.

The Committee of Adjustments of the City of Toronto refused to issue a variance for the stacks as a by-law restricted structures in the area to a height of 14 metres. The Committee held that their authority was restricted to minor variances and that a height of 30 metres was not a minor variance. Anchor Cap appealed to the Ontario Municipal Board and the OMB ruled that it was a minor variance and that the Committee had jurisdiction. A variance was granted and construction of the stacks was completed on August 31, 1982.

A condition of the Appeal Board required the Ministry to monitor the effectiveness of the new stacks. A monitoring program, with the company in full production at various product lines was carried out around the plant prior to and after installation of the stacks. The monitoring results are being evaluated.

The Ministry surveyed the company's operations and identified other concerns and abatement measures. All paint and solvent wastes are drummed and shipped to a waste handler for recycling; none are discharged to sewers; about 75 gallons of water soluble oil are prepared daily and used up in the plant processing machines, there are no floor drains in the paint and solvent shops and the area is dyked to contain spills from entering floor drains in other parts of the plant; no action regarding floor drains in other plant areas was required; the paint stripping tank area outside the plant was dyked to confine spillages and prevent them from entering the sewers.

All required works were completed by October 31, 1982.

The Canadian General Electric Company Limited (CGE)

CGE carries on business at several locations in and around the Triangle. Its resin manufacturing operation at 940 Lansdowne Avenue, outside the eastern boundary of the triangle, was considered a potential odour source and the following works were identified as being necessary for abatement control.

Construction of an interceptor tank to receive all floor and peripheral yard drains of the resin manufacturing building; a high level alarm system and supervised batch discharge to the sewer system; sampling and evaluation of odours to conform and to agree upon solvent level for discharge; keeping of a log book and samples for evaluation by the Ministry or Metro and the City staff. The batch discharge and sampling program provide control over the quality of sewer discharges. For spill control, the company was required to have clean-up equipment and absorption material on hand and to make staff aware of responsibilities to clean up spills promptly and to notify the Ministry. Prominent notices on spill procedures are displayed in the work place.

Pressure sensors and low pressures alarms are installed in the reactor system so that upset conditions can be brought under control by the removal of heat and application of cooling. As a back-up control system, all reactors are fitted with rupture disks which allow for discharge into large diameter lines to a holding tank. The Ministry was satisfied that all works were in place at the end of October 1982 and that the company was in full compliance with our requirements.

Viceroy Manufacturing Company

Viceroy carries on a manufacturing operation at 1655 Dupont Street; it manufactures plastic and rubber goods.

The potential for odorous spill prevention was met by having the solvent shop install permanent dykes to prevent discharges to floor and yard drains; instructions to staff to notify control agencies of all spills and to have equipment and clean-up material readily available on hand; the logging and recording of all spill activities. An up-to-date sewer system layout of the plant was provided to the City and was reviewed for change that might have been required to prevent accidental spills from entering the sewer system. All paint and solvent wastes are drummed and taken away by a licenced industrial hauler. All works were completed by October 31, 1982.

Nacan Products Limited

Nacan Products Limited operates an adhesive manufacturing plant at 371 Wallace Avenue. The company had been required to undertake works over the past decade to meet Ministry standards. The intensive program of abatement saw improvements to the plant operation and by the end of October 1982 only two of the several works identified had not been carried out. The company submitted a voluntary program with scheduled dates for the completion of the two remaining works. The Director accepted the program and a Program Approval was issued on the company on February 28, 1983. The Program Approval document is attached as Appendix D.

Inmont Canada Incorporated

Inmont operates a paint and ink manufacturing plant at 303 Campbell Avenue. The company undertook an abatement improvement program for several works and submitted a voluntary program with scheduled dates for further abatement works which are to be completed by the end of December 1983. The Director accepted the program and a Program Approval was issued on the company on February 28, 1983. The Program Approval document is attached as Appendix E.

Glidden Company

The Glidden Company operated a resin manufacturing plant up to March 31, 1983, and continues to operate a paint manufacturing plant at 351 Wallace Avenue. Over the years, the Ministry has

required improvements to the company's operation to comply with environmental standards. Although the company had install control equipment over the years additional works were identified. The company undertook a program to separate, monitor and treat odorous process wastewaters prior to discharge to the sewer system by the construction of a separator with level alarms. A training program and a spill contingency plan was in place. The company did not agree with the Ministry's position that some operations were causing odorous emissions to the air nor with our request for abatement measures to control such emissions. As a result, the Ministry carried out a survey of the company's operations and issued a Provincial Officers Report under Section 126 of the Environmental Protection Act.

The Ministry served notice on the company that a Control Order would be issued to achieve the recommendations of this report. The company agreed with the findings of the report with one exception; it agreed that while its operations are likely to cause problems it had not been proven that they had caused problems. Our position was confirmed when the company was convicted on May 6, 1983 for emitting a contaminant on June 24, 1983.

The Control Order (Appendix F) was issued on the company on March 25, 1983.

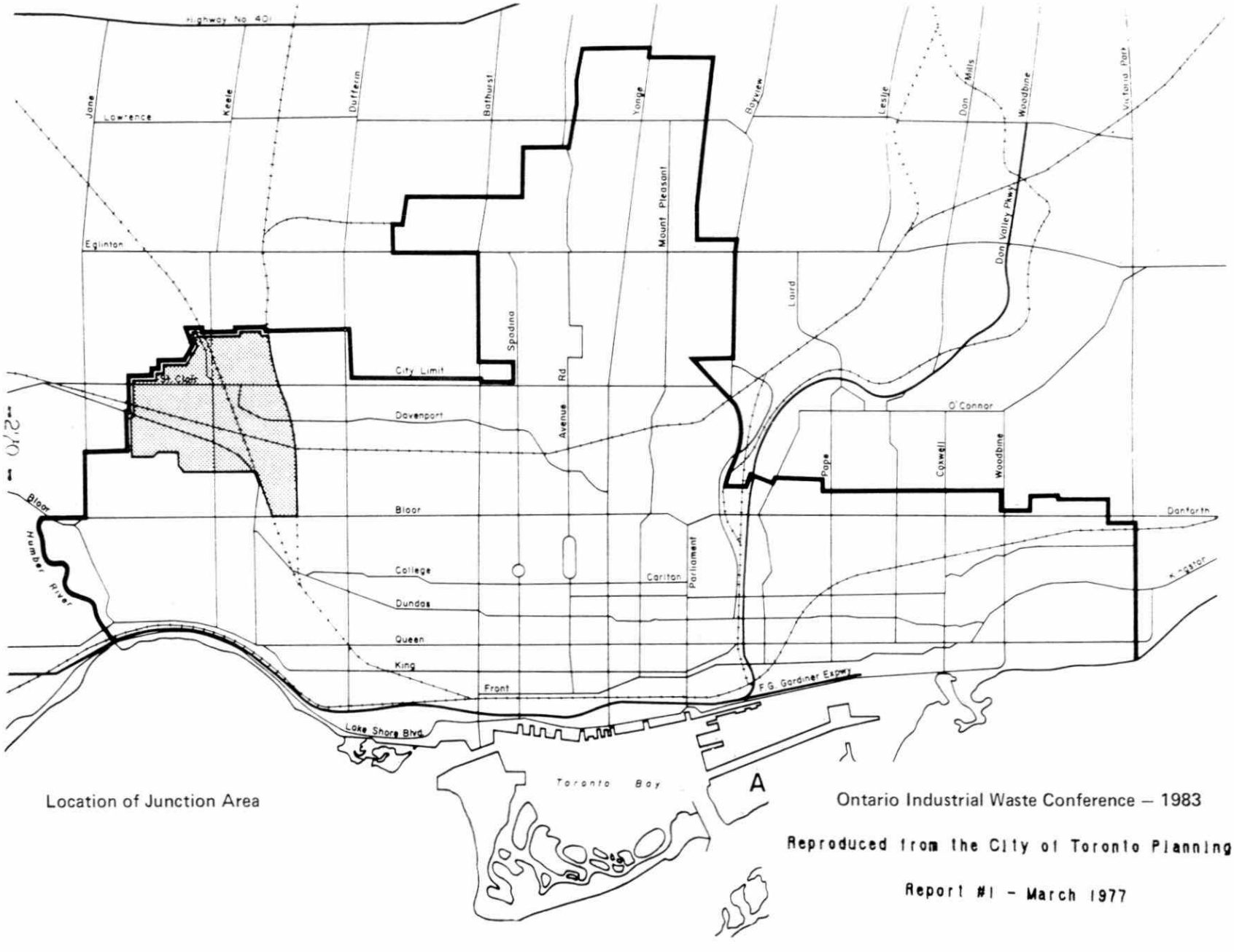
The Environmental Liaison Committee

The last 14 months of intensive abatement activities have seen improved signs of communication between the citizens, the companies, and government officials. The suggestion for an Environmental Liaison Committee, which I made at the first public meeting, has received universal support from the area industries, the two citizens groups and the Ministry, and was a recommendation of the Mayor's Action Task Force. The composition of the Committee has been determined and it should start functioning before the end of summer.

I have great hopes for a successful role for this Committee in pollution abatement management; misconceptions about how industries operate and dispose of their wastes will be corrected; citizens will no longer feel frustrated about their problems as they will have ready access to the companies that "cause" these problems and to those who are entrusted with the management of the environment on their behalf and will come to know these people; there would be freer exchange of information; as co-operation replaces confrontation, fear and suspicion would be replaced with trust and respect. The future is exciting as all parties embark on a new adventure of learning how to compromise, to make trade-offs and to co-exist. These are essential elements of good environmental management programs. No progress in human endeavours are without adverse environmental impact - for when our early ancestors discovered how to make fire, which all agree was a good thing, they initiated a form of air pollution which is still with us today.

ACKNOWLEDGEMENT

The success of the programs is due to the dedication and hard work of many Ministry staff; they are acknowledged in Appendix F.

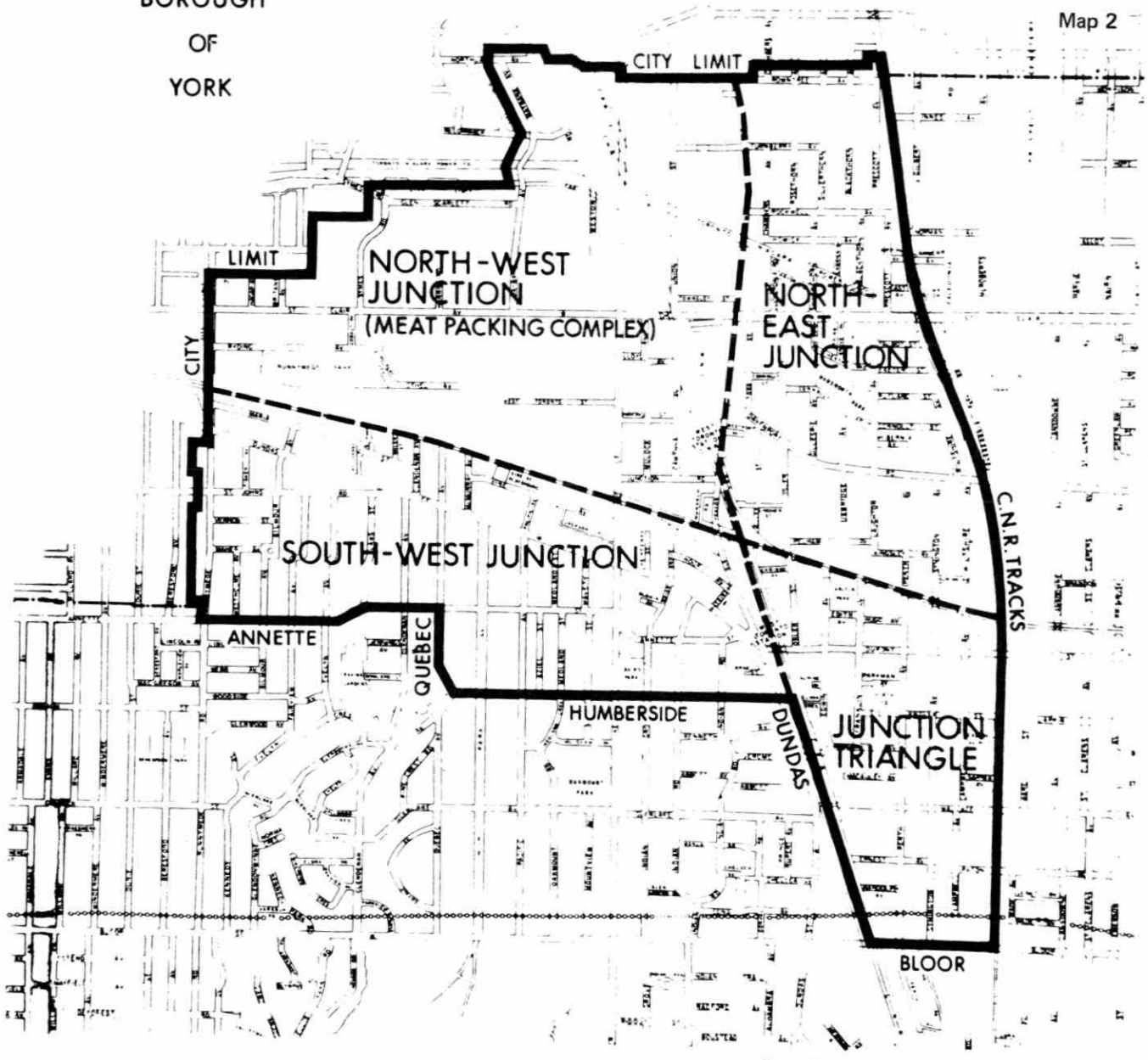


Location of Junction Area

Ontario Industrial Waste Conference – 1983

Reproduced from the City of Toronto Planning Board

Report #1 - March 1977

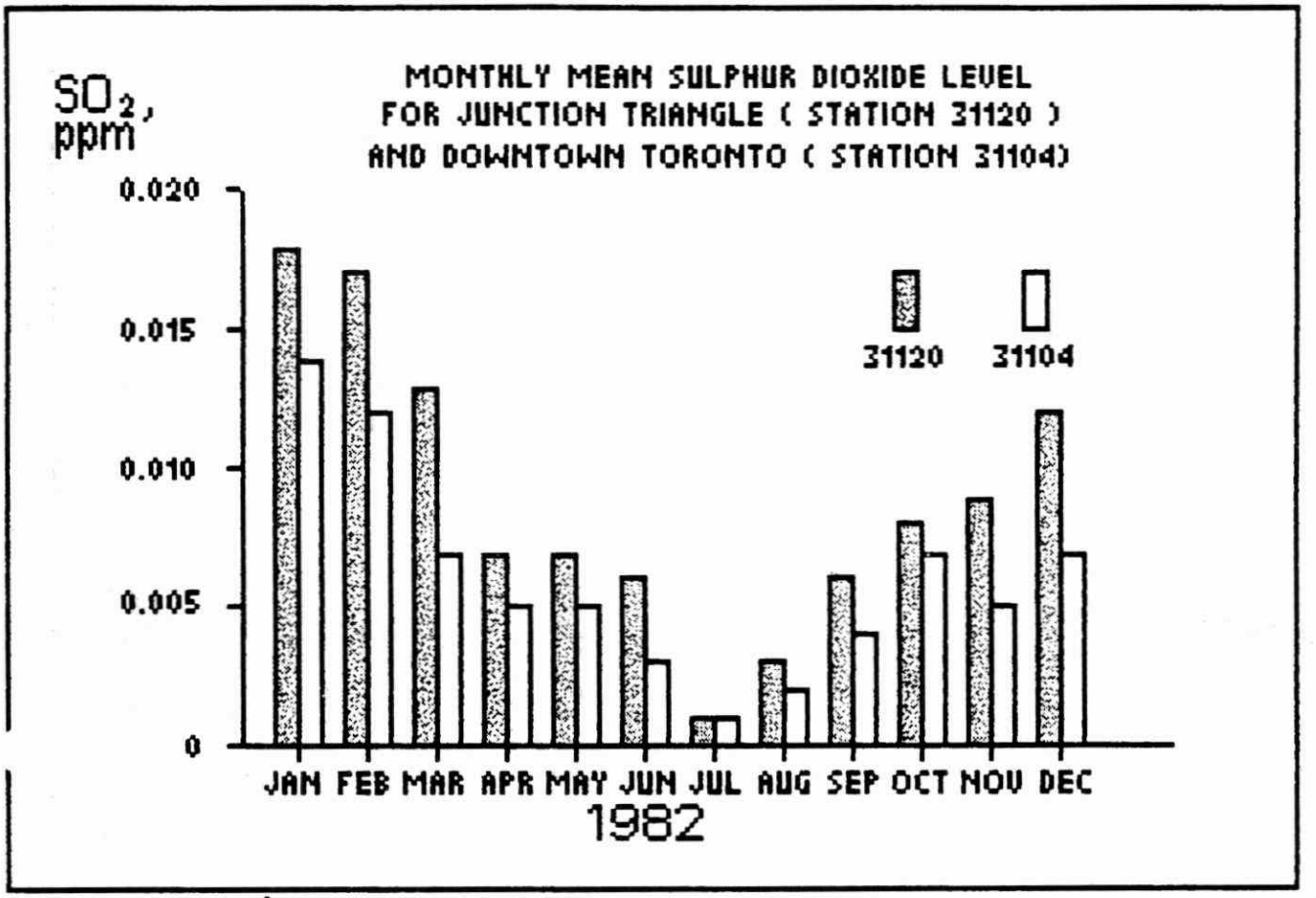


Sub-areas of the Junction

Ontario Industrial Waste Conference

Reproduced from the City of Toronto Planning Board

Report #1 - March 1977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FOR JUNCTION TRIANGLE (STATION 31120)
AND DOWNTOWN TORONTO (STATION 31104)
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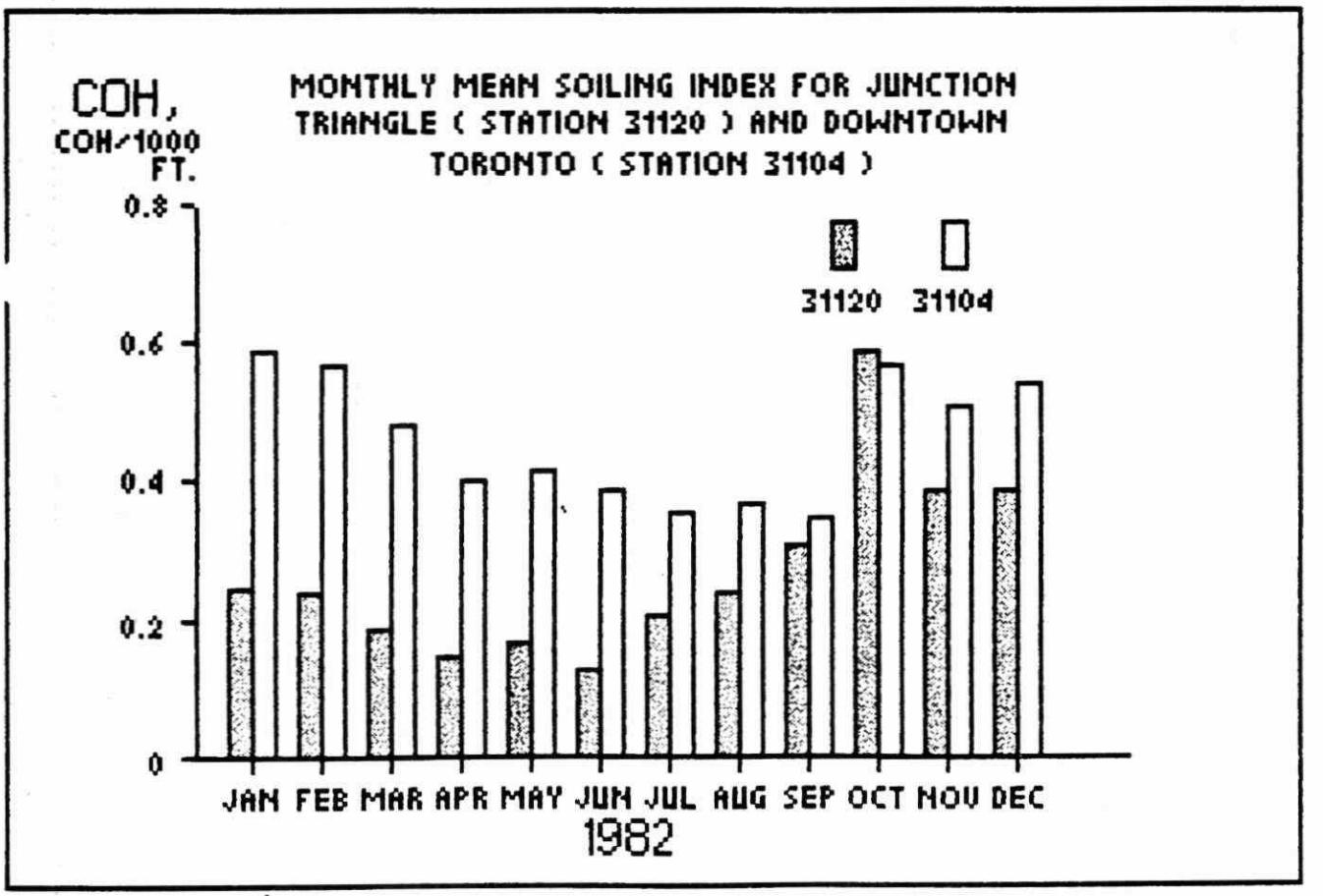
0.015
0.010
0.005
0
31120
31104
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982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COH/1000 FT.
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TRIANGLE (STATION 31120) AND DOWNTOWN
TORONTO (STATION 31104)
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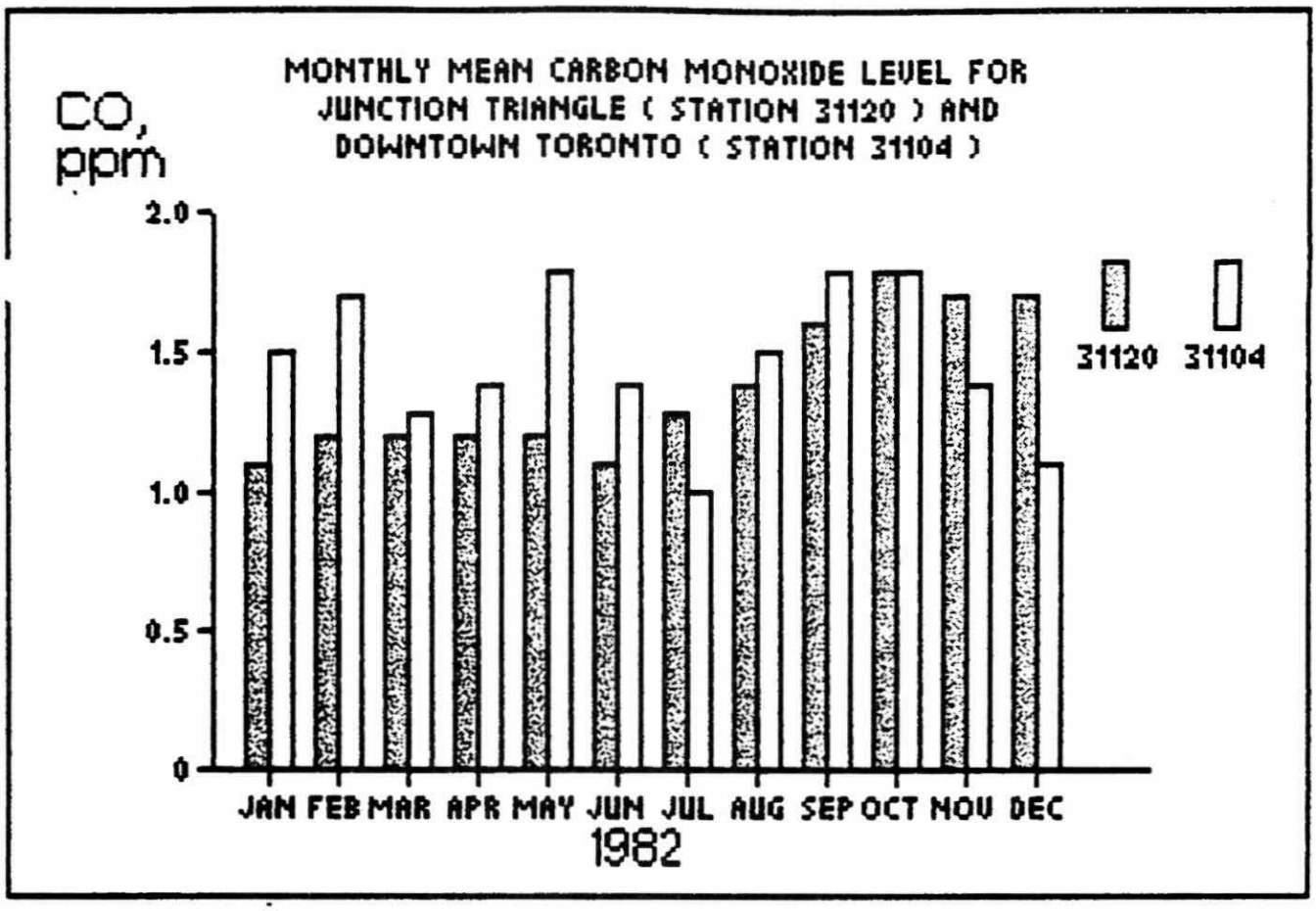
0.4
0.2
0
31120
31104
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982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JUNCTION TRIANGLE (STATION 31120) AND
DOWNTOWN TORONTO (STATION 31104)
CO, ppm
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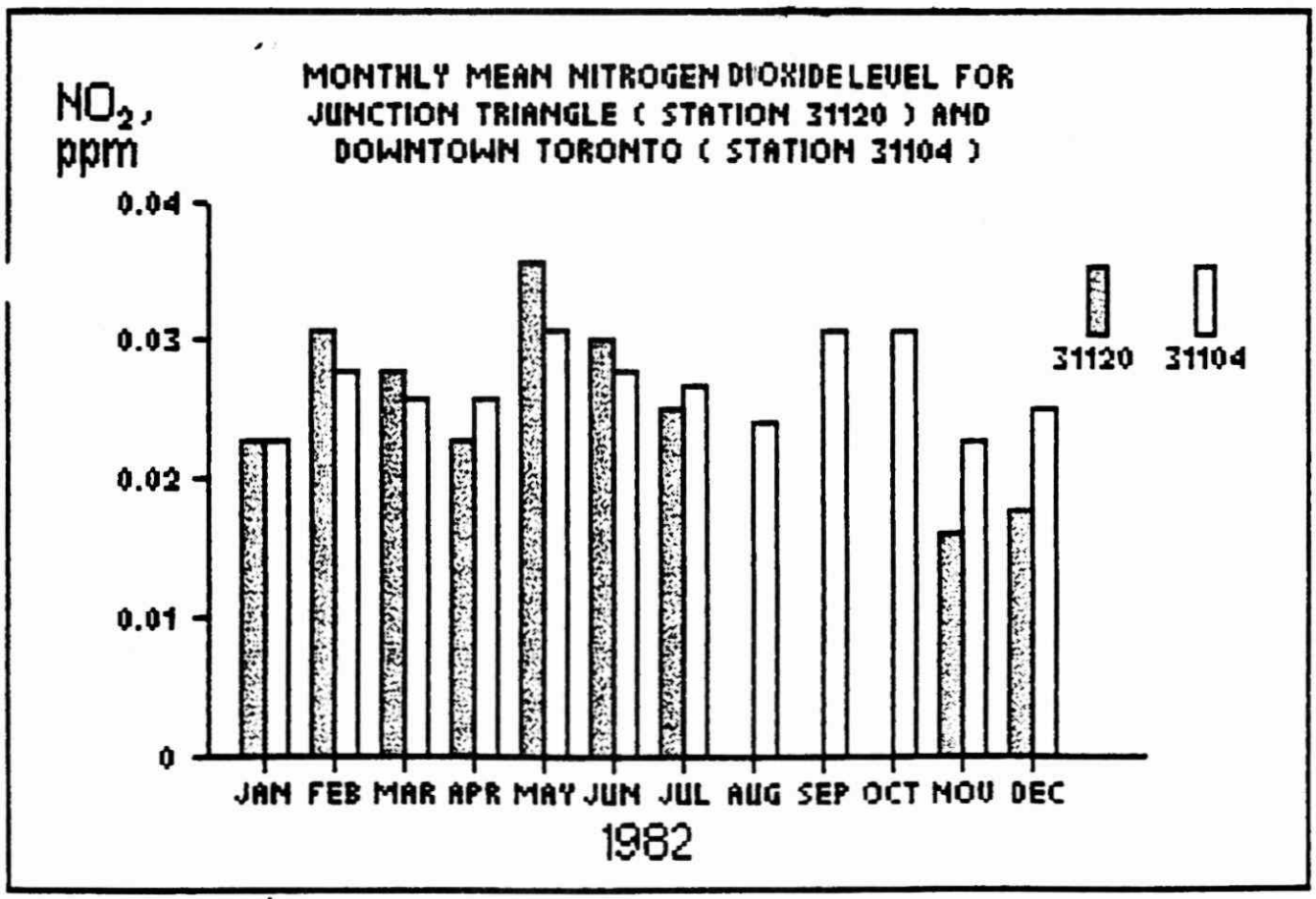
1.5
1.0
0.5
0
31120
31104
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982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DOWNTOWN TORONTO (STATION 31104)
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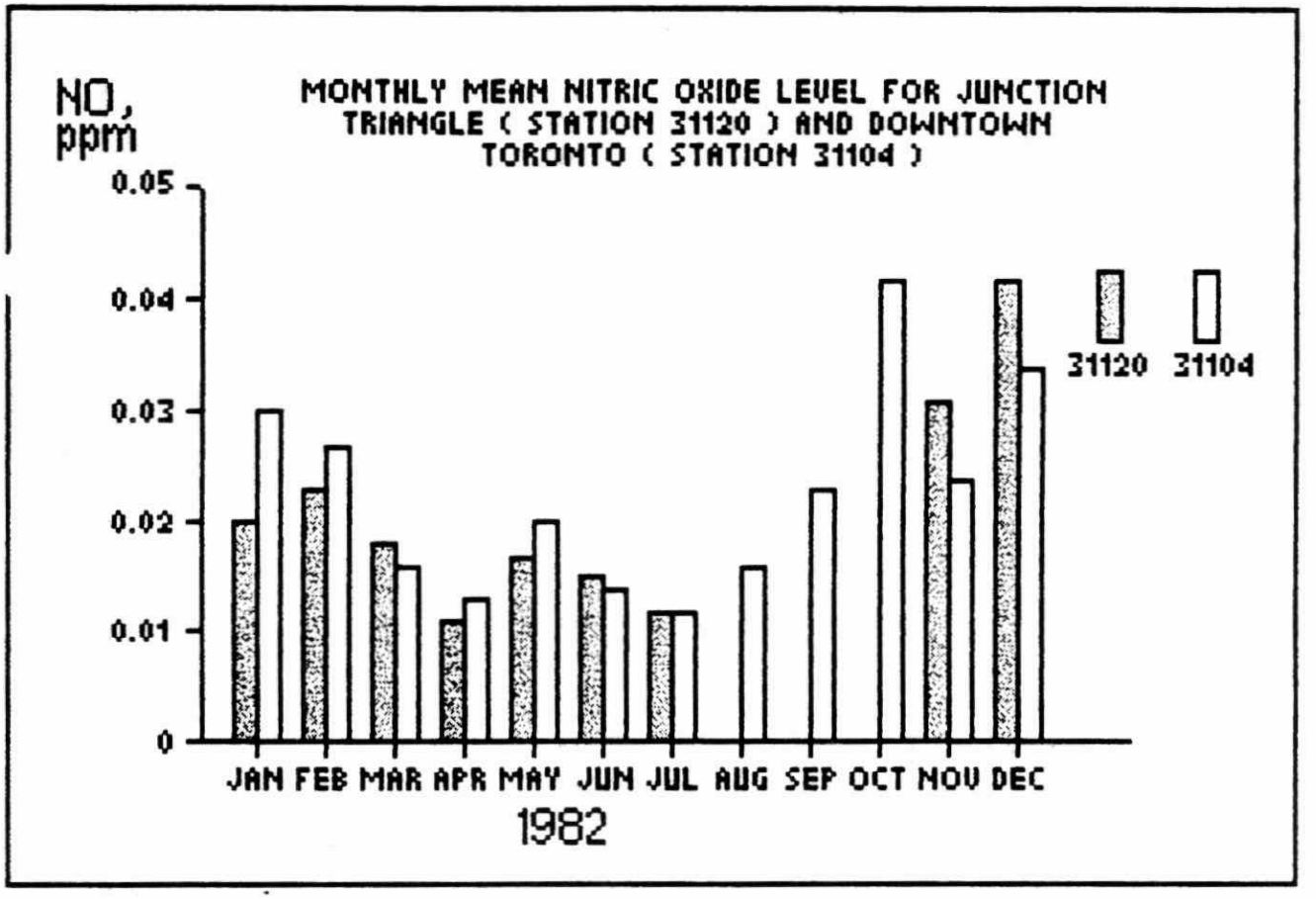
0.02
0.01
0
31120
31104
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982


NO,
ppm
MONTHLY MEAN NITRIC OXIDE LEVEL FOR JUNCTION
TRIANGLE (STATION 31120) AND DOWNTOWN
TORONTO (STATION 31104)
0.05
0.04
0.03
0.02
0.01
0
31120
31104
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982

APPENDIX A

SUMMARY AND INTERPRETATION OF THE ENVIRONMENTAL STUDY OF THE JUNCTION TRIANGLE SECTION OF THE CITY OF TORONTO

In 1980 the Ontario Ministry of the Environment carried out an air monitoring program in the Junction Triangle area during a two-week period. The program was carried out in response to air quality concerns of area residents. Environment Ontario used their highly sophisticated Mobile Air Monitoring Unit (MAMU) for this purpose.

This unit is best described as a super sniffer complete with a computer and weather station on wheels. Its instruments test for common industrial pollutants such as hydrocarbons, hydrogen sulphide, and sulphur dioxide. Pre-selected complex industrial pollutants can also be measured in extremely low concentrations.

Monitoring of the Junction Triangle area, bounded by Bloor, Dupont and Dundas Streets and Lansdowne Avenue began on Thursday, July 17 and ended on August 1, 1980.

The following are the highlights of the survey:

Ozone and total hydrocarbons were monitored on a continuous basis. This enabled Ministry staff to record instantaneous maximum peak levels as they occurred. Slightly elevated instantaneous ground level concentrations of total hydrocarbons were detected in the immediate area of the companies with maximum concentrations of hydrocarbons being recorded at the property lines of Glidden Paint Company and Anchor Cap and Closure.

Ozone levels recorded throughout the survey were low and in keeping with normal background levels.

During the periods when elevated levels of total hydrocarbons were detected, 5-10 minute air samples were collected and analyzed for specific hydrocarbon composition. The recorded levels of the 18 hydrocarbons selected and analyzed for this survey represent a mean value of the sampling period.

Of the 18 chemical substances monitored in the survey, 1,2,4 tri-methyl benzene, and 1,3,5 tri-methyl benzene and ethyl acrylate showed levels that were slightly elevated above normal urban levels. The tri-methyl benzenes are fractional components of petroleum distillates used as solvents throughout the paint and coatings industry. Ethyl acrylate is a liquid monomer noted for possessing a very low odour threshold level. These odorous contaminants were found in the immediate vicinity of Glidden Paint and Anchor Cap and Closure.

It can be concluded from this study that local residents are subjected, from time to time, to short-term exposure of malodorous air contaminants resulting from manufacturing activities of the principal industries in the Junction Triangle area. It is further recognized that the extent of this exposure to odours is variable with the wide range of raw materials used by these industries. A major concern for both the residents and the Ministry has been the possibility of long-term health effects from exposure to these compounds. Our medical advisors in the Ministry of Labour have attempted to assess this aspect of the matter but are hampered by the lack of specific knowledge in the scientific literature. For most of these chemical substances the results of exposures to high concentrations are known. Guidelines exist for the protection of workers who are exposed to them and observance of these guidelines is usually adequate to protect their health. The air levels of the compounds which occur in the Junction Triangle area are all well below those specified for occupational exposures and, as a result, one would not expect to see any obvious health effects. At this time it is not possible to state whether minor decrements to health could result from long-term residence in such an environment, as small changes in health which might result over long periods of time would be difficult or impossible to distinguish from similar changes which accompany the normal aging process. In the light of present knowledge it appears that the nuisance of unpleasant odours and sporadic episodes of irritation of the eyes and other tissues may be the only significant effects. The more these can be controlled, the less likelihood there would be for a possibility of long-term health effects.

This monitoring program reaffirmed the Ministry's past observations and concerns for odour emissions from industry in the Junction Triangle area. These concerns were addressed in the past by requiring certain industries to undertake odour abatement actions which are outlined below.

Anchor Cap and Closure

This company has complied in part with the Amending Control Order issued December 5, 1978, by installing an electrostatic precipitator to control malodorous smoke emissions from their plastisol ovens. However, the company has failed to comply with that part of the Control Order which requires malodorous emissions from the lacquer ovens and lithograph ovens to be controlled by December 30, 1979, and are appealing this directive. The company has been charged with failure to comply with this section of the Control Order. These charges are presently being held in abeyance pending the court's resolution of the company's appeal in this matter.

Nacan Products

The company conducted stack sampling in August, 1980 to identify the odour components of the emissions. An engineering study was completed on May 15, 1981. The company will submit a proposal based on this study to this Ministry for the control of these emissions by July 1981.

Glidden Company

This company installed two packed scrubbing towers in December 1979 to minimize odorous emissions at a cost of approximately $200,000. In addition, since December, 1979, the company discontinued the open kettle resin manufacturing operation, adhesive manufacturing and have reduced lacquer manufacturing by 90%. Curtailment of these operations further reduces the release of potentially odorous emissions.

With the completion of the foregoing abatement programs, significant advancement in controlling odour emissions from these industries will have been accomplished and the industries will have, for the most part, installed "state of the art" control technology. However, as long as private residences remain in such close proximity to manufacturing operations there will always be the potential for some unpleasant odour incidents to occur in the community.

In keeping with the intent of this study, Environment Ontario will continue to provide surveillance on the operations of the companies in question and where it is technically feasible these industries will be required to install available "state of the art" technology to control even further, emissions from their respective process operations.

PW:cra:F1-N3
1981 06 03

APPENDIX B

JUNCTION TRIANGLE ALERT PLAN

1. Any municipal department or either of the Ministries of the Environment or Labour will, on receipt of the notification of an airborne odour or a chemical spill, immediately inform the Fire Department, telephone 363-2133.

2. The Fire Department will, on receipt of notification of an airborne odour or chemical spill, contact the Ministry of the Environment, telephone 424-3000 (24-hour number) and take immediate action to respond to the call. Police are automatically notified on calls received through the '911' Emergency Number, otherwise they are to be notified by the Fire Department.

3. The Ministry of the Environment being notified of an airborne odour or chemical spill will take immediate action to respond to the incident.

4. The Fire Department, on the basis of the on-scene report, should the sewer system be involved, will contact the Metropolitan Toronto Department of Works, telephone 367-8211 (24-hour number), and the City of Toronto Department of Public Works, telephone 367-7737 (24-hour number). The City of Toronto Department of Buildings and Inspections are to be contacted should chemical storage facilities be involved. If a perceived threat to health is present, the Fire Department will also notify the Medical Officer of Health (367-9111).

5. The Fire Department, should an on-scene report establish a chemical spill has occurred that is contained or partly contained within a building, will contact the Ministry of Labour, telephone 273-7800 daytime or 965-1211 after hours, weekends and holidays.

6. If a threat to health is present, the Medical Officer of Health will notify the City of Toronto Board of Education (Mr. Ronald W. Halford, Associate Director of Education - Operations at 598-4931), and the Metropolitan Separate School Board (Mr. Bernard Falley, Assistant Director of Education at 922-3212 and 921-7086), who have a plan of action at the school level to deal with the evacuation and care of school children.

7. The Fire Department will advise the Mayor's Office of the occurrence and action being taken. The Fire Department will advise the City Department of Buildings and Inspections, the Medical Officer of Health, and the Planning and Development Department of the occurrence and action taken.

8. Industry officials to be contacted by Police Department as necessary.

NOTE:

Contact numbers for all governmental agencies are filed with the Fire Department.

F1-N4

Ontario

APPENDIX C

MINISTRY OF THE ENVIRONMENT

PROGRAM APPROVAL

TO:

Nacan Products Limited
371 Wallace Avenue
Toronto, Ontario
M6P 3P1

Attention: Mr. J.M. Shepherd
Vice President, Engineering

Nacan Products Limited operates an adhesive manufacturing plant located at 371 Wallace Avenue in the City of Toronto.

Nacan Products Limited has requested, by letter dated November 5, 1982 approval by the Director for the following program.

The following measures have already been implemented as indicated:

1.	Separation of the reactors' used cooling water stream from the process waste stream to sewer discharge at the Polyvinyl Emulsion Building.	completed, July 30, 1982
2.	Installation of parts for an interceptor for sewer discharge control at the Polyvinyl Emulsion Building as follows:	
	(a) sealed drain on interceptor	completed, October 9, 1982
	(b) installed pump, piping and valves.	completed, September 21, 1982
	(c) installed pump controls and instrumentation	completed, October 9, 1982
	(d) installed liquid hydrocarbon automatic sensor and alert alarm system	completed, October 6, 1982
	(e) installed high level automatic alarms and electrics	completed, October 6, 1982

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3.	Installation of probes and instrumentation for high level automatic pump cut-off system on two preliminary ('slow-add') tanks at the Polyvinyl Emulsion Building	completed, October 22, 1982
4.	Testing of underground storage tanks for butyl acrylate and vinyl acetate.	completed, September 23, 1982
5.	Use of protective manhole covers with flame arrestors for rail tank cars during vinyl acetate unloading.	use, initiated September 1, 1982
6.	Piping for butyl acylate monomer transfer in the Polyvinyl Emulsion Building re-arranged for simpler operation.	completed, August 15, 1982
7.	Logging procedure for transfers of vinyl acetate and butyl acrylate to show cumulative meter readings.	in effect since April 20, 1982
8.	Installation of a sampling manhole for sewer effluent from the main building.	completed, August 9, 1982
9.	Spill contingency control procedure.	in effect

10. Agreement to instruct personnel through written operating procedure to have them operate thereafter the unloading, of bulk materials from tank truck and rail cars to storage facilities with the yard drain plugged during the transfer.

11. Agreement to continue 'back-venting' bulk unloading of butyl acrylate from tank trucks to storage tanks.

12. Agreement to continue yearly testing of underground tanks, or as often as necessary to prevent underground leaks of vinyl acetate and butyl acrylate to sewers.

13.	Conservation vents from underground storage tanks for polyvinyl acetate and butyl acrylate have been extended to 35 feet above grade. Dispersion calculations show contaminant concentrations below odour threshold levels.	completed in 1973
14.	Company study submitted to indicate adequacy of reactor condensers to control emissions, during normal operation.	submitted, July 1, 1982 and approved, September 17, 1982

15.	Maintain compliance with the Metropolitan Toronto Works By-Law on sewer discharge temperatures.	compliance since 1959
16.	Installation and the continued use of 'dry-locks' on bulk transfer hoses to minimize odours and spills.	installation completed, and use initiated October 15, 1982
17.	Continue the operation of the interceptor at the Polyvinyl Emulsion Building by:	initiated December 15, 1982

(a) operating the automatic hydrocarbon sensor and recorder, and the recorder for the interceptor pumpout.

(b) ensuring that all process waste water enters the interceptor;

(c) ensuring that all interceptor wastes are held and checked for odours and hydrocarbons before release to the municipal sewers;

(d) ensuring that if the interceptor wastes are odorous and/or contain hydrocarbon in excess of Metro By-Law Regulations, the waste will not be released to municipal sewers and will be drummed and transported as liquid industrial waste to be disposed of in a proper facility;

(e) maintaining process records to show the operation of process wastes interceptor for Ministry examination, measuring and recording the amount of effluent pumped out each time, and making the records available to the Ministry;

(f) maintain samples of each effluent batch for ten days for examination by Ministry.

18. Immediately and thereafter continue to use the high level automatic pump cut-off system on two (2) 'slow-add' tanks in the Polyvinyl Emulsion Building, and take appropriate action to prevent spills. now in effect

The remaining measures will be implemented by the dates indicated.

1. By June 1, 1983, install an inhibitor addition system for the reactors in the Polyvinyl Emulsion Building to control erupting odorous reaction materials, or take alternate measures of odour control, such as installation of a surge tank, so that emissions comply with the standards prescribed in Section 13 1(a) and 1(c) of the Environmental Protection Act.

2. By June 30, 1983, install an exhaust system, including a high stack, designed to control fugitive emissions from the Polyvinyl Emulsion Building, or install an alternate means of odour control, so that emissions comply with the standards prescribed in Section 13, sub-sections 1(a) and 1(c) of the Environmental Protection Act.

Pending implementation of this Program Approval, Nacan Products Limited will take all steps necessary to minimize the emissions of contaminants.

Therefore, pursuant to the authority vested in me by Section 9 and 10 of the Environmental Protection Act the program as set out previously is hereby approved.

G. Mierzynski, P.Eng.
Regional Director

Issued at Toronto, this 28th day of February 1983.

L1/EE

Ontario

APPENDIX D

MINISTRY OF THE ENVIRONMENT

PROGRAM APPROVAL

TO: Inmont Canada Inc.
303 Campbell Avenue
Toronto, Ontario
M6P 3V8

Attention: Mr. C.A. Huff
Director of Manufacturing

Inmont Canada Inc. (Inmont) operates a paint and ink manufacturing plant located at 303 Campbell Avenue in the City of Toronto.

Inmont has requested, by letter dated November 5, 1982, approval by the Director for the following program.

The following measures have already been implemented as indicated:

1.	Construction of a drain seal for the ramp of the Ink Building to prevent possible odorous spills from entering sewers.	completed, May 24, 1982
2.	Construction of a drain seal in the central yard area to prevent possible odorous spills from entering sewers.	completed, June 17, 1982
3.	Construction of a drain seal in the south yard area to prevent possible odorous spills from entering sewers.	completed, Sept. 15, 1982
4.	Construction of drain seals for all floors of the Resin Manufacturing Building to prevent possible odorous spills from entering sewers.	completed, July 28, 1982
5.	Re-location of off-loading and receiving of bulk liquid raw materials from the front to the back of the Resin Manufacturing Building.	completed, June 3, 1982

6. Supervision will be provided at all times during unloading and loading of bulk liquid materials.

7. Improved security will be implemented to minimize possible spills by vandalism.

8. Construction of an inspection manhole for sampling of sewer discharges from the Resin Manufacturing Building. — completed, October 26, 1982

The remaining measures will be implemented by the dates indicated:

1. By March 31, 1983, submit a written technical engineering study on the capability of the resin reactors emission control system to ensure that odorous emissions comply with standards prescribed in Section 13 1(a) and 1(c) of the Environmental Protection Act. If the study shows that odorous emissions require control, the company shall, by April 30, 1983, submit plans with a schedule of implementing the abatement plans so that emissions comply with the standards prescribed in Section 13 1(a) and 1(c) of the Environmental Protection Act.

2(a) By March 31, 1983, investigate and submit a written technical report to the Ministry of Environment on sewer discharge rates, characterization of contaminants, and other relevant information on the existing sewer discharge system.

(b) By May 31, 1983, determine the required effluent control method and equipment and submit the proposal to the Ministry of Environment.

(c) By September 30, 1983, install the required equipment and initiate the continuous operation and method of control using the following instrumentation and control procedures:

(i) install and continue to use an automatic audible high level alarm to ensure that wastes do not discharge directly to the sewer;

(ii) install and continue to use a pump for pumping out the effluent to the sewer. Measure and record the amount of effluent pumped out and make the records available to the Ministry;

(iii) install and continue to use an automatic hydrocarbon analyzer that will detect excess hydrocabron and alert personnel by audible alarm to take action, and remove the hydrocarbon wastes to drums for disposal as liquid industrial wastes;

(iv) assess effluent for odour and hydrocarbons and take appropriate action by drumming off odorous and excessive hydrocarbon wastes for proper disposal as liquid industrial wastes;

(v) record on the manifest the odour intensity and the hydrocarbon level, and the disposition of the effluent, and make the manifest available for the Ministry's perusal.

(vi) a sample of the effluent shall be taken once per shift and kept for 10 days for the Ministry's evaluation.

3. By March 31, 1983, install a reactor surge tank system for the Resin Manufacturing Building to contain erupting odorous reactants and to control these odours, so that emissions comply with the standards prescribed in Section 13 1(a) and 1(c) of the Environmental Protection Act.

4. By September 30, 1983, install a tall stack and exhaust system or an alternative method and/or equipment in the Resin Manufacturing Building to control fugitive odorous emissions, including emissions from reactor openings and filter press operations, to comply with the standards prescribed in Section 13 1(a) and 1(c) of the Environmental Protection Act.

5. By December 31, 1983, install a tall stack and exhaust system, or an alternative method and/or equipment for the Manufacturing Building to control fugitive odorous emissions, including odorous emissions from open tanks and varnish storage tanks, so that they comply with the standards prescribed in Section 13 1(a) and 13 1(c) of the Environmental Protection Act.

Pending implemention of this Program Approval the company will take all steps necessary to minimize the emissions of contaminants.

Therefore pursuant to the authority vested in me by Sections 9 and 10 of the Environmental Protection Act the program as set out previously is hereby approved.

G. Mierzynski, P.Eng.
Regional Director

Issued at Toronto this 20th day of February, 19 83

L3/B

Ontario

MINISTRY OF THE ENVIRONMENT

NOTICE

TO:

GLIDDEN COMPANY
Division of SCM (Canada) Limited
351 Wallace Avenue
Toronto, Ontario

Attention: Mr. A. Roos, Vice-President, Managing Director

TAKE Notice that pursuant to the authority vested in me by Section 6 of the Environmental Protection Act, and for the reasons set out below, I intend to issue a Control Order directed to you in relation to the emission of odours from your manufacturing plant situated at 351 Wallace Avenue, Toronto, into the natural environment. I intend to issue this Order because the report prepared in accordance with Section 126 of the Environmental Protection Act, enclosed herewith, filed with the Ministry, contains the following findings:

1. The odours arising from the operation of the two resin manufacturing reactors and their associated equipment are likely to cause impairment of the quality of the natural environment or material discomfort to persons, contrary to Section 13(1)(a) and (c) of the Environmental Protection Act, R.S.O. 1980.

2. The odours arising from the resin manufacturing building (Building No. 16) are likely to cause impairment of the quality of the natural environment or material discomfort to persons, contrary to Section 13(1)(a) and (c) of the Environmental Protection Act, R.S.O. 1980.

3. The odours emitted from the lacquer manufacturing processes and building are likely to contribute to the odour problems arising from the plant.

4. The odours emitted from the equipment cleaning room in Building No. 2 are likely to contribute to the odour problems arising from the plant.

5. The odours arising from the paint manufacturing operations in Building Nos. 9 and 1 are likely to cause impairment of the quality of the natural environment or material discomfort to persons, contrary to Section 13(1)(a) and (c) of the Environmental Protection Act, 1980.

6. The emissions from the underground raw materials storage tanks are likely to cause impairment of the quality of the natural environment contrary to Section 13(1)(a) of the Environmental Protection Act, R.S.O. 1980.

7. Spills, storage and handling of drums and other activities in the yard are likely to contribute to the odour problem arising from the plant and cause impairment of the quality of the natural environment, water or watercourse, contrary to Section 13(1)(a) of the Environmental Protection Act, R.S.O. 1980.

8. The odours arising from discharges and accidental spills into the sewers are likely to cause impairment of the quality of the natural environment or material discomfort to persons, contrary to Section 13(1)(a) and (c) of the Environmental Protection Act, R.S.O. 1980.

By letter dated November 12, 1982, Glidden Company advised the Ministry that it intended to close its Wallace Avenue Resin Reactors and take out of service the majority of its underground storage tanks shortly thereafter. The requirements of the Order have been modified as appropriate in response to this information.

THEREFORE, I hereby give notice in accordance with Section 116(1) of the Environmental Protection Act of my intention to issue a Control Order directing you to:

1. Take steps to ensure that the emissions of odours from the operation of the two resin manufacturing reactors, five weigh tanks, three thinning tanks, two venturi scrubber boxes, two seal boxes, and two decanter tanks will not result in contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980 by closing the resin reactors by March 31, 1983 or by the following:

   A. By March 31, 1983:

      (1) re-examine, with the scrubber manufacturing, proper packing, operation and scrubbing solution requirements for the two packed scrubbers, and

      (2) re-design the scrubbing solution spray distribution system to achieve uniform distribution of the scrubbing solution, and

      (3) determine the appropriate scrubbing solution circulation rate for maximum effectiveness; and

      (4) install an appropriate instrumented scrubbing solution concentration control system, with recording and alarm mechanism, or an equally acceptable system, and

(5) re-design the scrubbing solution preparation and circulation system to ascertain the supply of the scrubbing solution at all times, without interruptions, during the operation of the reactors and their associated equipment. This requires installation of at least one additional scrubbing solution preparation and circulation tank, and

B. By April 30, 1983, submit an application for a Certificate of Approval for the modifications to the packed scrubbing systems, outlined in Item 1 A.

C. By July 31, 1983, make modifications to the packed scrubbing systems in accordance with the terms and conditions of the Certificate of Approval and thereafter operate the scrubbers according to operating procedures at all times during the operation of the reactors and their associated equipment.

D. By September 30, 1983:

(1) determine odour concentrations and emission rates in the packed scrubber stacks, under conditions representing the emission of the most odorous compounds, in accordance with the methods and procedures acceptable to this Ministry while the emissions from the resin reactors are:

(i) passing, under normal conditions, through the packed scrubbers and stacks to the atmosphere, and

(ii) by-passing the packed scrubbers via the by-pass ducts and scrubber stacks to the atmosphere,

(2) By October 31, 1983, submit the result of odour testing to this Ministry.

E. If the tests show that the emission of odours from the two scrubber stacks is likely to result in contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980, take the following steps:

(1) By December 31, 1983, submit an application for a Certificate of Approval for an appropriate extension to the scrubber exhaust stacks.

(2) By April 30, 1984, extend and modify the scrubber exhaust stacks in accordance with the terms and conditions of the Certificate of Approval.

F. By May 31, 1983 for each reactor:

(1) install a tank of sufficient capacity for the containment of a batch of resin, and connect the rupture disc vent of the reactor to the tank, or

(2) provide an equally acceptable system or reactor overpressure control,

to prevent uncontrolled emission of resin into the environment and contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980, when the rupture disc fails.

2. Take steps to ensure that the emission of odours from the resin manufacturing building (Building No. 16) will not result in contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980 by closing the resin reactors by March 31, 1983 or by the following:

A. (1) By March 31, 1983, install liquid high level alarms for weigh tank Nos. 3 and 4 to prevent overfilling the weigh tanks.

(2) By March 31, 1983:

(i) clean and inspect the quick connectors of the material transfer pipes and hoses, and the flexible connecting hoses for wear and,

(ii) replace worn-out connectors and hoses, and

(iii) implement a connector and hose inspection and cleaning program that is satisfactory to the Ministry.

(3) By March 31, 1983 eliminate storage of materials in open containers.

(4) By March 31, 1983 implement a spill contingency program, acceptable to the Ministry; and submit a copy of the contingency plan manual to the Ministry.

B. By March 31, 1983, submit an application for a Certificate of Approval for a ventilation system of the resin building (Building No. 16) including:

(1) an exhaust fan of sufficient capacity (subject to the approval of the Ministry of Labour) and

(2) an exhaust stack, extending at least 30.5 metres (100 feet) in height above the grade,

to serve the following:

(i) the operating room of the reactors, and

(ii) the filter press hood, and

(iii) the room containing the filter press, and

(iv) Dowtherm tank vent.

C. (1) By September 30, 1983 install the building ventilation system in accordance with the terms and conditions of the Certificate of Approval.

(2) By October 31, 1983 discontinue the operation of the existing building exhaust fans.

3. Take steps to ensure that the emission of odours from the lacquer manufacturing processes and building (Building No. 4A) will not result in contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980 by the following:

A. (1) By March 31, 1983, and thereafter, eliminate storage of materials in open containers, and

(2) By March 31, 1983 implement a spill contingency program acceptable to the Ministry, and submit a copy of the contingency plan manual to the Ministry.

B. By April 30, 1983 submit an application for a Certificate of Approval for a ventilation system of the lacquer processes (in Building No. 4A) including:

(1) close capture hoods and exhaust fan, or several exhaust fans, of sufficient capacity, (subject to the approval of the Ministry of Labour), and

(2) an exhaust stack, or several individual stacks, extending at least 17 metres (56 feet) above the grade, without the conventional rain cap(s) and discharging upward,

to serve the following:

(i) the Torit baghouse, and
(ii) the blending tanks (loading) area, and
(iii) the filter press area, and
(iv) the drum filling area.

Provision should be made in the design and construction of the stack and foundation to

accommodate a higher stack (100 ft.), if required later for added odour dispersion.

C. (1) By December 31, 1983, install the process ventilation system in accordance with the terms and conditions of the Certificate of Approval.

D. By April 30, 1984, assess odour emissions from existing building ventilation fans and, if found to be excessive, by the Ministry,

E. By October 31, 1984, exhaust building ventilation air through a 17-metre (56-foot) stack.

4. Take steps to ensure that the emission of odours from the equipment cleaning room in Building No. 2 will not result in contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980 by the following:

A. By April 30, 1983, submit an application for a Certificate of Approval for a ventilation system of the equipment cleaning room in Building No. 2, including the following:

(1) an exhaust fan, or several exhaust fans, of sufficient capacity (subject to the approval of the Ministry of Labour) discharging upward above the building roof, to serve the following:

(i) the caustic cleaning tanks area, and
(ii) the general cleaning room area in Building No. 2.

(2) an exhaust stack extending at least 17 metres (56 feet) above the grade, without the conventional rain cap, and discharging upward, to serve the existing tank cleaning area fan. Provision should be made in the design and construction of the stack and foundation to accommodate a higher stack (100 ft.), if required later, for added odour dispersion. Emissions from the cleaning room may be directed to a common stack, also serving process emissions from the lacquer room (ref. Item 3).

B. (1) By December 31, 1983, install the ventilation system in accordance with the terms and conditions of the Certificate of Approval.

(2) By January 31, 1984, discontinue the operation of the two existing wall fans, located near the caustic cleaning tanks.

5. Take steps to ensure that the emission of odours from the paint manufacturing operations in Buildings Nos. 9 and 1 will

not result in contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980 by the following:

A. By March 31, 1983, and thereafter, minimize the emission of odours into the room air by:

(1) eliminating the storage of drums and other containers in the room not immediately essential in the manufacturing process, and

(2) covering up the remaining drums and containers when not in immediate use, and

(3) providing properly fitting covers to those mixing kettles not so equipped and maintaining the covers in place during the mixing and other operations, and

(4) implementing a spill contingency program acceptable to the Ministry, and submitting a copy of the contingency plan manual to the Ministry.

B. By April 30, 1983, submit an application for a Certificate of Approval for an exhaust stack, for the existing Wheelabrator baghouse, of a minimum height of 30.5 metres (100 feet) above the grade.

C. By December 31, 1983, install the stack in accordance with the terms and conditions of the Certificate of Approval.

6. Take steps to ensure that the emissions from the underground raw materials storage tanks will not result in contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980 by the following:

A. By April 30, 1983, for every raw material storage tank containing volatile materials that presently is not fitted with a back venting system, install and operate an enclosed back venting system that transports the displaced storage tank fumes back into the delivery truck tank, during filling operations.

B. By April 30, 1983, submit an application for a Certificate of Approval for the installation of an odour control device or devices such as:

(1) chemical scrubber(s), or
(2) carbon absorbers, or
(3) fume incinerator(s), or
(4) any other device(s) acceptable to the Ministry,

on the vents of the underground storage tanks containing raw materials having low odour threshold levels,

including (but not limited to) the following: Ethyl acrylate, methyl methacrylate, butyl acrylate, styrene, vinyl acetate, toluene, xylene, acetone, and methyl ethyl ketone.

C. By August 31, 1983, install, and thereafter operate at all times, the odour control device or devices in accordance with the terms and conditions of the Certificate of Approval.

D. By April 30, 1983, submit to this Ministry an acceptable program for pressure testing, metallurgical examination, and replacement of the underground storage tanks.

E. By July 31, 1983, implement the program submitted under Item 6D.

F. By January 1, 1985, complete the pressure testing program submitted under Item 6D.

G. By April 30, 1983:

(1) install level indicators in all underground storage tanks, or

(2) submit an alternate acceptable proposal of level control to prevent overfilling of the storage tanks.

H. The steps set out in paragraphs A to G inclusive need not be implemented in relation to any underground storage tanks taken permanently out of service by April 30, 1983 provided that Glidden Company identifies these tanks in writing prior to that date.

I. The steps set out in paragraphs D through G inclusive need not be implemented if the remaining underground tanks are taken permanently out of service by November 30, 1983.

J. By May 31, 1984, remove all underground tanks from the ground.

7. Take steps to prevent contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980 by the following:

A. By June 30, 1983:

(1) discontinue storage of drums containing materials in the unpaved areas in the yard, and

(2) discontinue filling of drums in the unpaved areas in the yard, and

(3) (i) pave the rail car unloading area with an impermeable material, or

(ii) install a sufficiently large tray of impervious material under the rail car in the unloading area to prevent spills into the ground, and

(4) pave the surface underneath the pumps located outside, at the west tank farm, with an impermeable material, and construct impermeable dikes around this area, and

(5) pave the surface underneath the storage tank loading pipe terminal, at the west tank farm, with an impermeable material and construct impermeable dikes.

B. By April 30, 1983, implement a yard spill contingency program, acceptable to the Ministry; and submit a copy of the contingency plan manual to the Ministry.

C. By April 30, 1983:

(1) cover up the containers under the overflow pipes of the seal boxes and venturi scrubber boxes, and thereafter keep them covered at all times, and

(2) thereafter inspect and empty the containers frequently to prevent overflow, and

(3) if an overflow occurs, clean up immediately.

8. Take steps to ensure the emission of odours from the spills into the sewers will not result in contravention of Section 13 of the Environmental Protection Act, R.S.O. 1980 by the following:

A. By July 31, 1983, install a high level alarm in the interceptor sump, and a hydrocarbon detector complete with recorder and audible alarm in the cascading interceptor system.

B. Thereafter, operate the interceptor system at all times to remove spills of oils, solvents and other odorous materials from the wastewater prior to discharging the latter into the sewer, and

C. Obtain daily samples of effluent discharged from the interceptor system and retain for a period of ten days for examination by Ministry and municipal works departments. If any time that the effluent is judged to be odorous or to contain hydrocarbon in excess of Metro By-Law Regulation, the waste is not to be released to

municipal sewers but is to be treated as liquid industrial waste and disposed of accordingly.

D. Maintain records of effluent monitoring data for the Ministry's perusal.

As provided by law, you may make submissions to the Director at any time before the issuing of the Control Order and the Order may not be issued until fifteen (15) days after the service of this notice:

Written submissions may be sent to:

The Director
Central Region
150 Ferrand Drive
Don Mills, Ontario
M3C 3C3

Dated at Toronto, this 28th day of FEBRUARY 1983.

G. Mierzynski
Director

L-I

APPENDIX F

The success of the abatement program is due to the dedication and hard work of many Ministry staff. Several of them were called upon to work beyond the call of duty at inconvenient hours and for long periods. Their dedication made my work easier and I wish to express my gratitude to them all and especially to the following - Don Bartkiw, Leo Butko, Derek Haldane, Jun Kawasaki, Peter Lessio, George Mierzynski, Don Ogner, Ed Sennema, Peter Wolfe, John Swaigen.

The contribution of the Mayor, Mr. Art Eggleton and those who served on the Action Task Force, as well as staff of other organizations especially the Fire Department of the City of Toronto require recognition. I am grateful for their support and assistance.

F1-N7

APPENDIX G

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F1-N5

MANAGEMENT OF FOUNDRY SOLID WASTES

by

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and James Halliday

The Proctor & Redfern Group
Don Mills, Ontario

A foundry may be defined as a manufacturing establishment where a molten metal, or metal alloy, is formed to a predetermined shape by pouring it into a shaped container, or mold and allowing it to solidify. After solidification, the casting is removed from the mold and is subjected to a variety of treatment processes to yield the desired end product . Although there are other metal forming methods, casting offers several advantages; e.g. it is adaptable to intricate shapes, to extremely large pieces, to mass production and it can provide parts with uniform properties throughout.

Castings may be made from a wide variety of materials, including various types of iron, steel, aluminum, copper, bronze and zinc. Foundries are major consumers of waste materials; in addition to scrap iron and steel used for ferrous castings, reclaimed copper, aluminum, tin, lead, zinc and other metals are also utilized in the making of castings.

A "captive" foundry is one whose products are used within the corporate structure and are incorporated into other products that are sold by the company. A "jobbing" foundry is one that undertakes custom founding for clients and uses none of its production capacity to make castings for its own use. Captive foundries are particularly prevalent in the automotive industry and machine tool manufacturing. In Ontario, for example, 34% of the total iron foundry capacity is jobbing and 66% is captive (Pettet, 1981).

Metal casting is a major industry in Canada; the country ranks about tenth in the world in metal casting. Casting tonnages for Canadian foundries for the year 1981 are depicted in Table 1.

The industry also generates considerable quantities of solid wastes. In the ensuing sections the quantity and nature of these wastes are discussed

TABLE 1

Casting Tonnages in Canada
1981

Gray iron*	521,704
Ductile iron	210,162
Malleable iron	15,128
Steel	154,102
Copper base	11,955
Aluminum	953
Magnesium	618
Zinc base	24,040

*includes 39,741 tons alloy iron

Source: Anon., 1982

in some detail along with waste management practices currently in use by the industry. The information was obtained through an extensive literature review supplemented by telephone contacts and field visits with foundries, pollution control equipment manufacturers, trade associations, chemical suppliers and waste disposal firms.

CASTING PROCESS

Casting processes can be divided into sand casting, permanent mold casting, die casting and centrifugal casting. Molding methods where a sand aggregate is used to prepare the mold produce by far the largest quantity of castings. Sand molding (or sand casting) include (Heine et al., 1967):

1. green sand molding
2. dry sand molding
3. core sand molding
4. shell molding
5. miscellaneous sand molding processes:
   pit and floor molding, cement bonded sand,
   air-set sand, loam molding, CO_2 process,
   hot box etc.

Good castings cannot be made without good molds. In sand casting of course the characteristics of the sand employed are of paramount importance, and much has been written about sand specifications, handling storage and preparation (Taylor et al., 1959; Heine et al., 1967; Ashby, 1977; Strong, 1983). It is not possible to adequately describe the various aspects of the numerous molding processes and the chemistry of the multitude of binders used to hold together the sand aggregate without going into a voluminous digression. Such information, however, is readily available from a number of basic text books and has also been the subject of many articles appearing in such trade/technical publications as Modern Casting,

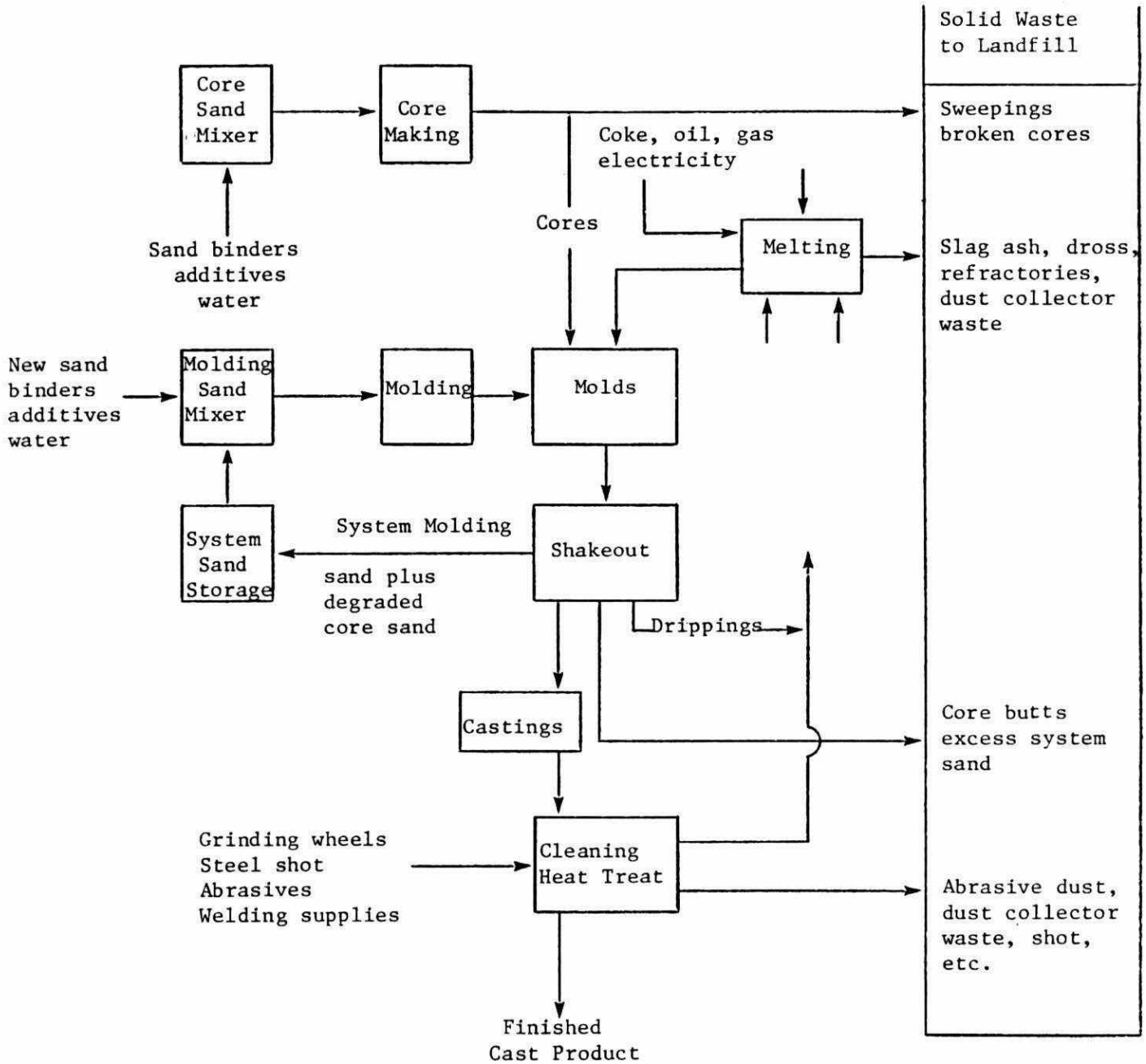
Foundry M&T and the Transactions of the American Foundrymen's Association (Heine et al., 1967; Taylor et al., 1959; Bailey, 1983).

Below is a brief description of the overall operations, i.e. sand preparation, mold and core making, metal melting and pouring, casting shakeout and cleaning and finishing, involved in the production of grey iron castings, malleable iron castings and steel castings which illustrates many of the fundamental aspects involved in metal casting. Fig. 1 and 2 also depict these steps in some detail.

Incidentally, a novel molding process which deserves more than a passing mention is the vacuum or V-process molding system. In the V-process, said to be a jobbing quantity casting method, sand molds are rigidized by packaging them into a thermoplastic film rather than using clay or other binders to maintain the mold shape. When the metal has been poured, the sand is dumped out, ready for reuse. Texas Steel of Canada Ltd. of St.Stephen, New Brunswick was the first foundry in Canada to install a V-process production line (Koekebakker, 1980).

Chief ingredients of clay bonded molding sands are silica sand, clay and water. These three components provide the bulk and plasticity reuqired of the molding sand. Incidentally, some foundries use olivine, zircon, chromite, biasill or other aggregates instead of silica sand. Besides these three basic ingredients, various other materials, called additives (see Table 2), may be incorporated into the sand mixture to enhance certain properties.

The molds are prepared by packing the molding sand around previously made patterns to yield the required shapes. Cores are required to complete the mold for castings having hallows or recesses.



Source = Boyle and Ham, 1979

FIG 1 FLOW OF MATERIALS IN GREEN SAND FOUNDRY PROCESSING.

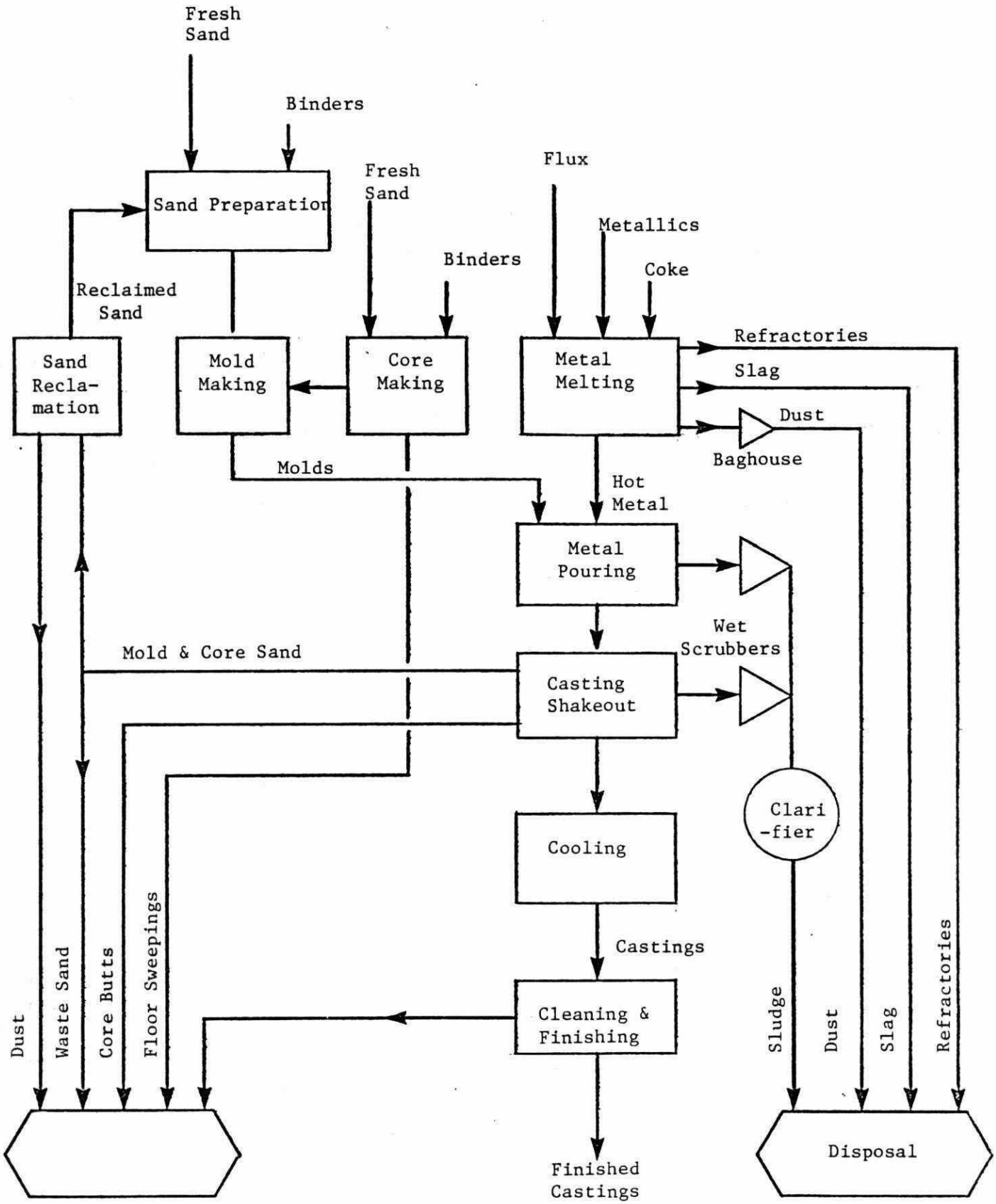


FIG 2 FOUNDRY OPERATIONS.

TABLE 2

Selected List of Special Additives
Used in Molding Sands

ADDITIVE	FUNCTION
Cereals (e.g. corn flour)	to increase green or dry strength or collapsibility
Ground pitch	to improve hot strength or casting finish on ferrous castings
Asphalt	to improve hot strength or casting finish on ferrous castings
Sea coal	to improve surface finish and ease of cleaning of ferrous castings
Graphite	to improve moldability of the sand and the surface finish of the castings
Gilsonite	to improve casting finish
Fuel oil	to improve moldability of the sand
Wood flour	to control the expansion of the sand, and the collapsibility and flowability of the sand
Silica flour	to increase hot strength of the sand
Iron oxide	to obtain added hot strength
Perlite	to increase the thermal stability of the sand
Molasses and dextrin	to increase dry strength of the sand and edge hardness of molds

Source: Heine et al., 1967

Sand for core making usually has to satisfy stringent requirements with regards to purity to ensure that the cores attain adequate strength. The desired properties of the cores are achieved by the use of special binders, the most common of which are (Leonard et al., 1977):

1. combinations of vegetable, fish and petroleum oils
2. phenol formaldehyde resin
3. sodium silicate
4. phenolic isocyanate
5. alkyd isoyanate
6. mixtures of urea and furfural alcohols

One of the main attractions of synthetic resin binders is that they confer a high dimensional accuracy and surface finish to the castings. Ashland Chemical Co. is one of the leading manufacturers of these types of binders. Besides the binders, many of the additives incorporated into molding sands are also often added to core sands.

Hardening of the cores is achieved by either baking (Item #1) or heat curing (items #2 and #6). For sodium silicate binders, hardening is accomplished by forcing CO_2 gas through the sand. Special catalysts are employed for the setting of isocyanate binders at room temperature. For the urea-furfural alcohol binders, setting is possible at room temperature or higher, depending on the type of catalysts employed.

Once the cores have been formed and cured, they are integrated with the final molds which are then conveyed to the metal pouring area. Molten metal of the desired composition is prepared in one of several types of commonly used furnaces. For the cupola furnace, the charge materials consist of a flux material, coke and metallics. Electric arc or induction furnaces do not require cake. Typical fluxes include limestone, fluorspar

and soda ash.

In North America, cupolas and electric induction furnaces are the most widely used for producing grey and ductile iron castings. Reverberatory furnaces account for only a tiny fraction. Steel castings are produced largely by electric arc furnaces while cupolas and electric induction furnaces account for the bulk of the malleable iron castings made. Furnaces used for the casting of other metals are discussed in some detail in several texts, for example in the books authored by Heine et al. (1967) and Taylor et al. (1959).

The molten metal is tapped from the furnaces into ladles and poured into the molds. At the high casting temperatures, the organic binders are largely burnt, pyrolized, boiled off or vaporized from the sand. Following solidification, the castings are separated from the molds in the shakeout area. The castings are cooled prior to cleaning and finishing, i.e. shot blasting, chipping and grinding.

Following casting shakeout, the mold and core sands are screened. Large remnants of undisintegrated cores (core butts) and large pieces of molding sand are conveyed to the disposal area. The bulk of the molding sand along with the degraded core sand, is returned to the molding sand preparation or it is passed through a reclamation system and then returned to either the core or molding sand mixing operation area.

SAND RECLAMATION

As the molding sand is reused, its workability deteriorates. The operating volume, although partly renewed by cores and the addition of fresh new sand, becomes gradually inferior. Thus, foundries facing rising costs for the purchase of new sand, shortage of proper disposal sites and increase

expenditures for the disposal of waste sand are starting to find sand reclamation processes very attractive. Centralized reclamation facilities, serving a number of foundries in a given geographical area, are also likely to become prevalent in the near future. According to one source, in almost all cases, the price of reclaimed sand is lower than the cost of new sand (Morgan and Maclear, 1983).

Reclamation of sand may be defined as the process of restoring used foundry sand to as nearly as its original condition as possible. The chief objective for reclaiming sand is to provide sand that is capable of being rebonded at a lower cost than new sand. It should be pointed out, however, that although most foundry sands are reclaimable, some are not; for example, compound sand grains which break down into irregular shape during the scouring action of the reclamation should be considered as not fit for reclamation (Zimnawoda, 1972).

Any casting facility contemplating the installation of a particular process or method of reclamation should first carefully analyze the factors listed in Table 3.

Sand reclamation systems can be classified as (Zayko, 1982; Zimnawoda, 1972):

1. mechanical attrition
2. pneumatic reclamation
3. wet reclamation
4. thermal reclamation

TABLE 3

Main Factors to Assess When
Considering Sand Reclamation

1. Quantity and characteristics of sand being disposed of.
2. Labor cost, trucking and disposal area charges.
3. Cost of new sand at the point of usage.
4. Chemical analysis of the material to be reclaimed.
5. End use of the reclaimed sand.
6. Disposal of wastes from the reclamation system.
7. Space requirements for the reclamation system and need for special auxiliary equipment to tie into the reclaimer.
8. Capital operating and maintenance costs of the reclamation system.

Source: Zayko, 1982

Because of their basic similarity, the first two are often referred collectively as mechanical reclamation.

In mechanical sand reclamation systems the chief objectives are to break down lumps into manageable size and eventually to grain size, remove as much residual binder and carbonaceous material as possible and to screen out remaining sand contaminants (Filipic, 1982). Pneumatic reclaimers are particularly versatile; they can handle a wide variety of molding and core sands (Smith, 1982). In addition, they are cost effective on a tonnage -basis and involve low maintenance. Although the dust generated by mechanical attrition units contains high levels of binders, the volume of such dust is small.

Wet reclamation systems are employed chiefly for the treatment of sodium silicate bonded sand since this binder is readily soluble in water. These units can also be used to reclaim core butts into new core sand quality for oil baked and phenolic resin cores as well as clay bonded molding sands since residual clay goes into suspension readily (Wasem, 1982).

In thermal reclamation the sand is heated to 1200-1500^{o}F (650-800^{o}C). Thermal systems are very efficient for the removal of organic binders and carbonaceous materials. Though not as effective as other reclamation techniques for the separation of clay from sand grains, some manufacturers claim clay removals as high as 50% (Deering, 1982). High efficiency and excellent quality of the reclaimed sand are the chief advantages of thermal reclamation; however, their capital costs and energy consumption are high. Thermal reclamation systems are already popular in Europe in Japan and the trend in North america also appears towards the thermal types.

There are three basic thermal systems on the market, namely the rotary kiln, the multiple hearth and the fluidized bed. Compared to other thermal units, the fluidized bed is low in capital cost and has a good fuel efficiency.

Thermal reclamation units are available from several suppliers. For example, Nichols Engineering & Research Corp., a Wheelabrator-Frye Co., offers fluid bed and multiple hearth furnaces for the reclamation of many types of foundry sand. When handling spent foundry sands that have been bonded with an organic binder, complete reclamation can be accomplished with these thermal reclaimers. With spent green molding sand containing both organic and clay bonding agents, these units prepare sand for subsequent mechanical scrubbing in equipment also available from the company.

GMD of Fort Worth, Texas also markets a fluid-bed calciner for thermally reclaiming various foundry sands. It consists of three close-coupled fluid beds processing the material through preheating, calcining and cooling on a continuous basis by means of hot air scrubbing and gravity transfer. Its thermal efficiency is 700,000 Btu/ton.

The system developed by Eirich Machines Ltd. combines thermal and mechanical reclamation in one and the same machine. If only mechanical attrition is needed, the burner system remains inactive. The company operates a pilot plant installation in their Maple, Ontario facility and has successfully tested a wide range of used sands. Main advantages cited for the Eirich sand reclaimer include:

1. sand is particulated and simultaneously cleaned
2. mechanical and pneumatic removal of the fines are attained independently
3. energy consumption per ton of sand is significantly less than with conventional units

QUANTITIES AND CHARACTERISTICS OF THE MAJOR SOLID WASTE STREAMS FROM FOUNDRIES

From the above discussion, it is evident that foundries are a source of considerable amounts of different solid wastes. Because of the many factors affecting the value and characteristics of the wastes produced, it is difficult to generalize. Moreover, until environmental regulatory agencies began to take a closer look at the metal casting industries, few foundries provided these regulatory bodies with detailed information regarding the quantity and quality of their wastes. Even though much work has been done in recent years on assessing the wastes from foundries, the picture is far from complete.

Generally speaking, over 75% of the wastes generated by sand foundries originate from coremaking and molding (Boyle and Ham, 1979). The remainder, i.e. slag, refractories, floorsweepings, dusts and sludges, arises from melting operations with small contributions from cleaning and heat treatment processes and air pollution control devices.

Solid waste contributions from three ferrous foundries in a survey condicted under the auspices of the American Foundrymen's Society are summarized in Table 4. All three used green sand molding but various coremaking processes. Similar results were found in another comprehensive study carried out on behalf of the US EPA (Leonard et al., 1977).

TABLE 4

Estimated Pounds of Material to Landfill
Per Ton of Metal Shipped

WASTES	FOUNDRY		
	MALLEABLE IRON	DUCTILE IRON	GRAY & DUCTILE IRON
Refractories	40 (2%)	53 (2%)	8 (1%)
Total Sand	1569 (88%)	2295 (79%)	1084 (73%)
Slag	96 (5%)	396 (14%)	270 (18%)
Other*	82 (5%)	151 (5%)	118 (8%)
Total	1787	2895	1490

* includes cleaning room waste, scrubber discharge, dust collector discharge

Source: Boyle and Ham, 1979

TABLE 5

Materials Used In, and Arising From
Chemically Bonded Sand Processes

	PROCESS	COMPOUNDS
1.	Shell process	phenol and substituted phenols, formaldehyde, ammonium compounds, hexamethylene — tetramine
2.	Hot-box process	phenol and substituted phenols, formaldehyde, ammonium compounds, hydrogen chloride
3.	Cold-setting resin binders	phenol and substituted phenols, phenol alcohols, urea, formaldehyde, ammonium compounds, toluene and xylene, sulfonic acid, sulfuric acid, phosphoric acid
4.	Cold-box process	diphenylmethane di-isocyanate, phenol and substituted phenols, amines, ammonium compounds
5.	Phenol-isocyanate	phenol, substituted phenols, diphenylmethane di-isocyanate, formaldehyde
6.	CO_2/silicate	sodium silicate

Source: Morley and Shaw, undated

TABLE 6

Factor Affecting Leachable Phenol Levels From Waste Sands

Sand-to-metal ratio

Binder type

Binder level

Phenol content in the binder

Degree of cure

Extent of binder thermal decomposition and rearrangement

Metal pouring temperature

Reclaim sand loss on ignition

Cooling time between pouring and shakeout

Source: Johnson, 1981

Incidentally, acording to one estimate waste sand from Canadian foundries amounts to some one million tons/year (Emery, 1979).

Foundry solid wastes can contain a wide variety of constituents for example, the compounds likely to be present in or to occur in sand as a result of the use of mold and core making chemical binders are listed in Table 5. However, the main pollutants of concern in foundry solid wastes are usually phenols and heavy metals.

The usual method of determining what constituents may be releaesd from solid wastes and thus contaminate the environment is to subjec the samples to leaching tests. During the past decade, a variety of leaching tests have been developed or refined (American Foundrymen's Society, undated; Cote and Constable, 1982a; Cote and Constable, 1982b; Josephson, 1982, Ham et al., 1981). Of course, there are many important variables to consider in any leaching test. Obtaining representative samples and preparing the samples for testing along with selecting the leaching medium, contact time, number of elutions as well as the appropriate analytical techniques for measuring the concentration of pollutants present in the leach solution are some of the key considerations. Although laboratory leaching studies generally aim to stimulate leaching which may occur in landfills, they are not representative of actual conditions in such waste disposal sites and therefore have often been criticized. Despite their shortcomings, laboratory leaching tests offer a quick and easy method for ascertaining what constituents may lead to environmental problems.

Discussed below are the most important results generated from a number of studies on the major foundry solid wastes, namely used sand, and dusts and sludges from air pollution control devices.

Essentially, any waste sand from a foundry core or mold process that

employs organic binders or additives may contain phenols. Consequently, most foundry waste sands are likely to contain traces of phenols. Leachable phenol levels vary from one waste sand to the next, depending on the factors depicted in Table 6. By maintaining low sand-to-metal ratios which results in very complete burning of the binder during pouring, and low LOI's on reclaimed chemically bonded sand, phenol levels in waste sand can be reduced to very low levels.

However, the only certain way to establish the amount of phenols in waste sand is to run leaching tests on representative samples.

Data generated on various extractables, i.e. phenol, formaldehyde and cyanide, by water wash of cured and uncured resin coated sand, and also of shakeout sand in a study conducted by Ashland Chemical Co. are summarized in Table 7. In these experiments, a 50-gram portion of sand was combined with 100 ml of water and after a thorough mixing the sand was allowed to settle and the water to remain in contact with the sand overnight. Afterwards, the water was separated from the sand filtration, and an additional 100 ml of water was filtered through the sand. Alternatively, 250 grams of sand was treated as above with 400 ml of water, and after filtering the leach solution, the total volume was made to 1000 ml by filtering additional water through the sand. From the results obtained, it is evident that there was very little leaching of cyanides from the samples, and that the curing of binders results in substantial reduction of leachable phenols and formaldehyde, and that shakeout sands contain negligible or very small amounts of leachable constituents.

In a study carried out in West Germany 11 different foundry waste sand samples were packed into a column 14 cm in diameter and 1 m high and then sprayed with 2 liters of rainwater for 12 hours, equivalent to 6 months of rainfall in West Germany (Morley and Shaw, undated). Concentration of

TABLE 7

Results of Water Leachables from Foundry Sands

Sand Mix	Phenol ppm	Formaldehyde ppm	Cyanide ppm
2.0% CHEM-REZ 158			
uncured - aged 1 week	158	13	< 0.2
cured - aged 24 hrs.	8	12	< 0.2
shakeout - 6" core	< 0.04	1	< 0.2
shakeout - 7" core	< 0.04	2	< 0.2
1.5% CHEM-REZ 224			
uncured - aged 1 week	5.2	7	< 0.2
cured - aged 24 hrs.	9	24	< 0.2
shakeout - 6" core	< 0.04	1	< 0.2
shakeout - 7" core	< 0.04	2	< 0.2
2.0% ISOCURE, 130/II 606			
uncured - aged 1 week	64	< 1	< 0.2
cured - aged 24 hrs.	9	< 1	< 0.2
shakeout - 6" core	< 0.04	< 1	< 0.2
shakeout - 7" core	< 0.04	< 1	< 0.2
1.8% LINO-CURE: A-15			
uncured - aged 1 week	0.2	< 1	< 0.2
cured - aged 24 hrs.	< 0.2	< 1	< 0.2
shakeout - 6" core	< 0.04	< 1	< 0.2
shakeout - 7" core	< 0.04	< 1	< 0.2
1.5% PEP-SET 1505/2590			
uncured - aged 1 week	9.4	6	< 0.2
cured - aged 24 hrs.	5.7	< 1	< 0.2
shakeout - 6" core	< 0.04	< 1	< 0.2
shakeout - 7" core	< 0.04	< 1	< 0.2
2.0% CHEM-REZ 105			
uncured - aged 1 week	1.1	224	< 0.2
cured - aged 24 hrs.	1	44	< 0.2
shakeout - 6" core	< 0.04	< 1	< 0.2
shakeout - 7" core	< 0.04	< 1	< 0.2
1.5% CHEM-REZ 480			
cured - aged 1 week	3	3	< 0.2
shakeout - 6" core	< 0.2	3	< 0.2
shakeout - 7" core	< 0.2	2	< 0.2

Source: Ashland Chemical Co., undated

phenols detected in the leachate was very low.

According to Leonard et al. (1977), when spent sands from ferrous foundries were subjected to extraction for heavy metals, no significant leaching of metals occurred. However, waste sand from brass foundries often contain appreciable levels of lead and thus they may be classified as hazardous (Smith et al., 1982).

In a project carried out at the University of Wisconsin, the objective was to determine the concentrations of cadmium, chromium and lead extracted from samples of cupola dusts or sludges collected from several grey iron foundries (Boyle et al., 1981). Another objective of the study was to assess the heavy metal concentration of mixed foundry wastes from the same sites.

Extraction procedures used included both the EPA extraction procedure (EP) and a distilled water extraction . The latter test was identical to the EP procedure except that the elution was conducted with distilled water rather than acetic acid. According to the EPA test, if the concentration of a particular species in the acid extracts equals or exceeds 100 times the drinking water standard listed for that species, the waste is classified as EP toxic. In this particular investigation, cadmium at an EPA extract concentration of 1 mg/L or greater, lead at 5 mg/L or greater, and chromium at 5 mg/L or greater were the ones specified as being of concern by the EPA.

According to the results obtained, the wastes from two foundries were cadmium toxic only; three were lead toxic only; and four were both cadmium and lead toxic, but none of the wastes were chromium toxic. Foundry processes most likely to generate EP toxic cupola dusts or sludges were electric arc furnaces and/or baghouses. This is partly due to the fact

that such wastes tend to be finer and more acidic than wastes from other processes sampled.

However, using the EP test procedure, but distilled water as the extraction solution instead of acetic acid, the cupola dusts or sludges from one foundry were found to be EP toxic with respect to cadmium. None of the samples were toxic with regards to chromium or lead.

When cupola dusts or sludges were mixed with other foundry wastes, their toxicity effects were diluted making the mixed wastes much less likely to be EP toxic. Mixed waste from one foundry was cadmium toxic, from two foundries were lead toxic and none were chromium toxic.

Of course, in addition to the waste streams mentioned above, there are other sources in foundries which give rise to wastes containing significant levels of pollutants. For example, Throop (1977) reported that sludge arising from the treatment of slag cooling water contained appreciable levels of chromium, zinc, iron and lead. The treatment process described in this publication consisted of primary clarification, heavy metals removal by pH, adjustment with lime, secondary clarification, gravity thickening and vacuum filtration.

ENVIRONMENTAL REGULATIONS

Although mot foundry wastes are nonhazardous, there are a multitude of rules and regulations governing the disposal of foundry solid wastes. In the United States, for example, on the federal level the Resources Conservation and Recovery Act (RCRA) requires that all generators of waste determine whether their wastes fit the definition of a hazardous waste and it also provides a framework of regulations for the control and disposal of

nonhazardous wastes.

According to RCRA, a solid waste is hazardous if it has not been excluded from regulation if it (Kunes et al., 1982a):

1. is included in the RCRA lists of hazardous wastes

2. is a mixture of solid waste and one or more listed hazardous wastes

3. exhibits any of the characteristics of hazardous waste; e.g. ignitibility, corrosivity, reactivity and EP toxicity.

The most important hazardous waste characteristic for the foundry industry is EP toxicity.

Disposal of some or all types of foundry wastes is also regulated in every state and often these are as stringent as the RCRA regulations and several states have also laws which allow the deregulations of certain foundry wastes (Kunes et al., 1982b). Interestingly enough, while the US EPA recognizes the mixing of hazardous wastes with nonhazardous wastes as a treatment process under certain circumstances, some states do not.

Disposal of foundry wastes is also closely regulated in Ontario and recently the Ministry of the Environment initiated a thorough and comprehensive review of all present waste management practices, policies and controls, including legislation, the so-called "Blueprint for Waste Management". This program will undoubtedly have a far reaching effect on foundry wastes.

Laws and regulations covering foundry wastes in Great Britain have been outlined by Morley and Shaw (undated) and those in West Germany in the report by Bradke and Klein (undated) while some of the pertinent regulations in Sweden may be found in the publication prepared by the Association of Swedish Foundries (1980).

WASTE DISPOSAL PRACTICES

In North America some foundries dispose of most or all of their solid wastes on their own property while others employ contract haulers to take their wastes to approved municipal or industrial landfills. Similar disposal methods are practiced in West Germany, Sweden and Great Britain, and no environmental problems have arisen from the disposal of phenol-contaminated foundry sand at properly managed sites in these countries (Bradke and Klein, undated; Association of Swedish Foundries, 1980; Jones and Terron, 1975; Morley and Shaw, undated).

Incidentally, rehabilitating old, abandoned quarries with solid wastes, including foundry wastes is particularly popular in some areas; for example, Steetley Industries operates such a disposal facility in Dundas, Ontario.

Much has been written in recent years about the disposal of foundry wastes in a company owned landfill and in commercial and municipal landfills. Detailed discussion of the many aspects of disposing foundry wastes in such sites, illustrated with ample case studies, may be found in the publications authored by the American Foundrymen's Society (undated), Boyle and Ham (1979), Kunes et al. (1982a), Kunes et al., (1982b), Smith et al. (1982) and Stephens and Kunes (1981).

UTILIZATION OF FOUNDRY WASTES

Foundry solid wastes have also found a variety of useful applications. For example, spent sand can serve as a kiln feed in Portland cement manufacture and as a raw material in asphalt plants (Association of Swedish Foundries, 1980; Emery, 1979). Quench slag and excess system sand have also been extensively employed as construction fill (Stephens and Kunes, 1981). Waste sand has also been successfully utilized in road construction. Moreover, foundry wastes, particularly sand, can be used as a supplement for daily cover in municipal landfills and there are several examples where foundry sand mixed with other solid wastes has been used as a final cover (Smith et al., 1982).

CONCLUSIONS

Based upon the above findings and considerations, the following may be concluded:

1. Foundries generate several types of solid wastes of which spent sand along with dusts and sludges from air pollution control devices are of the main concern.

2. Given the multitude of metals cast and the wide variety of chemical binders and additives used in foundries, numerous organic and inorganic pollutants may be present in the wastes; of those phenols and heavy metals are the most significant.

3. Although the published literature on the characteristics of foundry solid wastes is not very extensive, most foundry wastes can be regarded as nonhazardous. According to leaching studies, phenols and heavy metals from spent foundry sand usually do not pose environmental

problems, but sludges and dusts often contain appreciable levels of such heavy metals as lead, chromium and cadmium.

The American Foundrymen's Society is particularly active in studies centered around the quantities and characteristics of wastes generated by foundries.

4. Quantity of spent sand requiring disposal may be substantially decreased by the installation of sand reclamation systems. These may be classified as mechanical attrition, wet reclamation and thermal methods. The trend is toward the thermal types; however, by combining various reclamation processes, the advantages of each are fully realized.

   Because of the geographical location of foundries in Ontario (i.e. such facilities are concentrated mainly in the Golden Horseshoe area and the Niagara Peninsula), regional reclamation centers may be feasible in certain sites in the province.

5. All foundry solid wastes are clsoely regulated; the recently announced Ministry of the Environment "Blueprint for Waste Management" will undoubtedly have a significant impact on the management of foundry wastes in the province in the near future.

6. Currently, the most common disposal methods for foundry wastes are deposition into a foundry-owned landfill or into municipal or industrial landfills. In properly managed sites, no significant problems have been reported with regards to phenol pollution in the United States, Great Britain, West Germany and Sweden.

7. Foundry solid wastes, especially spent sand, have also found a number of useful applications; for example, used sand has been successfully utilized as cover material in landfills, as an ingredient in Portland cement and asphalt, and as a construction fill material. Undoubtedly, as waste utilization becomes more prevalent, many other beneficial uses will also emerge.

APPENDIX

American Foundrymen's Society
Gulf & Wolf Roads
Des Plaines, IL
U.S.A. 60016 Tel: (312) 824-0181

Ashland Chemical Co.
Foundry Products Div.
P.O. Box 2219
Columbus, OH
U.S.A. 43216 Tel: (614) 889-3014

Ashland Chemicals
2620 Royal Windsor Dr.
Mississauga, Ontario
L5J 4E7 Tel: (416) 823-1800

Eirich Machines Ltd.
P.O. Box 550
Maple, Ontario
LOJ 1EO Tel: (416) 832-2241

GMD
P.O. Box 79217
Fort Worth, TX
U.S.A. 76179 Tel: (817) 232-8143

Nichols Engineering & Research Corp.
Homestead & Willow Roads
Belle Mead, NJ
U.S.A. 08502 Tel: (201) 359-8200

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ULTRAFILTRATION: TREATMENT OF INDUSTRIAL EFFLUENTS FOR PRODUCT RECOVERY

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BURLINGTON, ONTARIO.

Due to the ever restrictive legal requirements for liquid waste disposal coupled with the increasing cost of liquid waste disposal, liquid waste reduction and recovery of valuable products by ultrafiltration is employed in more sectors of the industrial environment. Prime examples exist in the food processing, metal fabricating, plating, textile, photographic, mining and numerous other industries.

Ultrafiltration is basically a membrane filtration process on the molecular level by which solvent and solute molecules are separated by shape and size with some degree of influence from ionic strength and the pH of the solution.

Figure 1 shows the process of passing a feed solution under turbulent conditions, under pressure across the membrane surface. In this process the small molecules pass through the pores of the membrane and as the feed solution passes over the membrane surface again, it becomes more and more concentrated with large molecules. The liquid which passes through the membrane is called "permeate" and the feed solution which is concentrated is called "concentrate".

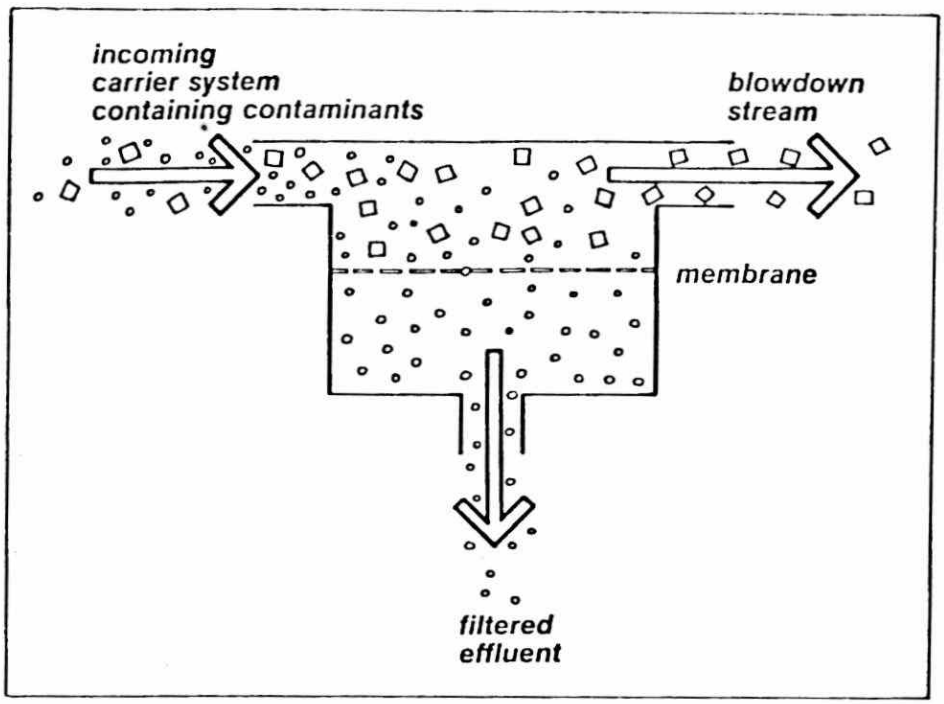
Permeate rate is a function of applied pressure, temperature, turbulent pumping flow, steric effects and the degree of concentration polarization.

Thus ultrafiltration can be used to selectively concentrate valuable components from wastestreams.

FIGURE 1

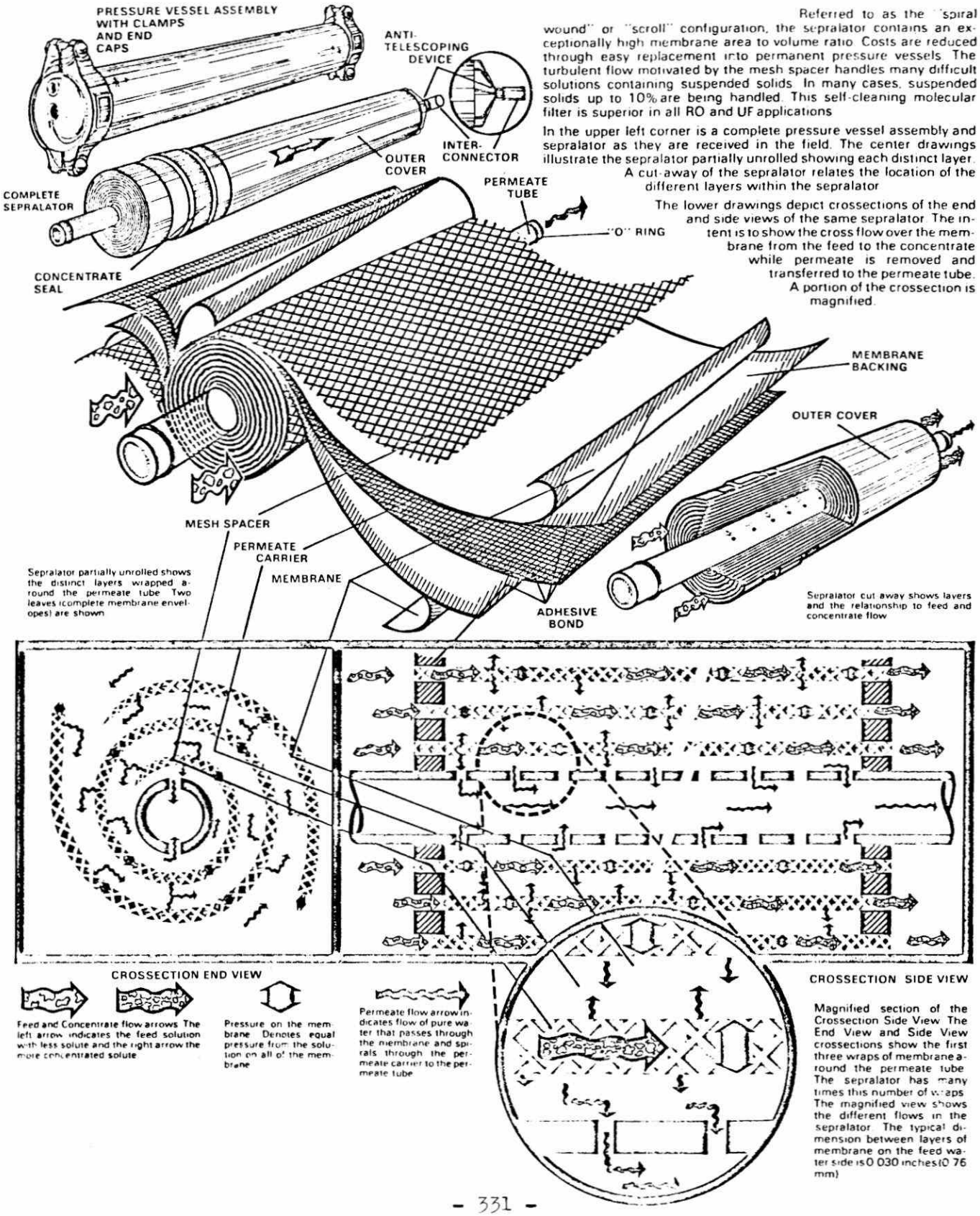
MEMBRANE ULTRAFILTRATION PROCESS

Wastewater is pumped under pressure to the semi-permeable membrane which permits passage of small molecules but retains the large ones.



Zenon employs both the spiral (as shown in Figure 2) and tubular (as shown in Figure 3) configuration employing different cellulosic and non-cellulosic membrane materials, eg., cellulose acetate and polysulfone. Ultrafiltration systems are available in industrial, industrial food grade and sanitary food grade designs. Ultrafiltration systems and/or pilot plants have been installed in the applications discussed in this paper for oil emulsions, textile wastewater, cheese whey and fish process water.

FIGURE 2


PRESSURE VESSEL ASSEMBLY WITH CLAMPS AND END CAPS
ANTI-TELESCOPING DEVICE
INTER-CONNECTOR
OUTER COVER
COMPLETE SEPRALATOR
PERMEATE TUBE
"O" RING
CONCENTRATE SEAL
MEMBRANE BACKING
OUTER COVER
MESH SPACER
PERMEATE CARRIER
MEMBRANE
ADHESIVE BOND
Sepralator partially unrolled shows the distinct layers wrapped around the permeate tube. Two leaves (complete membrane envelopes) are shown.
Sepralator cut away shows layers and the relationship to feed and concentrate flow
CROSSECTION END VIEW
CROSSECTION SIDE VIEW
Feed and Concentrate flow arrows. The left arrow indicates the feed solution with less solute and the right arrow the more concentrated solute.
Pressure on the membrane. Denotes equal pressure from the solution on all of the membrane.
Permeate flow arrow indicates flow of pure water that passes through the membrane and spirals through the permeate carrier to the permeate tube.
Magnified section of the Crossection Side View. The End View and Side View crossections show the first three wraps of membrane around the permeate tube. The sepralator has many times this number of wraps. The magnified view shows the different flows in the sepralator. The typical dimension between layers of membrane on the feed water side is 0.030 inches (0.76 mm).

Referred to as the "spiral wound" or "scroll" configuration, the sepralator contains an exceptionally high membrane area to volume ratio. Costs are reduced through easy replacement into permanent pressure vessels. The turbulent flow motivated by the mesh spacer handles many difficult solutions containing suspended solids. In many cases, suspended solids up to 10% are being handled. This self-cleaning molecular filter is superior in all RO and UF applications.

In the upper left corner is a complete pressure vessel assembly and sepralator as they are received in the field. The center drawings illustrate the sepralator partially unrolled showing each distinct layer. A cut-away of the sepralator relates the location of the different layers within the sepralator.

The lower drawings depict crossections of the end and side views of the same sepralator. The intent is to show the cross flow over the membrane from the feed to the concentrate while permeate is removed and transferred to the permeate tube. A portion of the crossection is magnified.

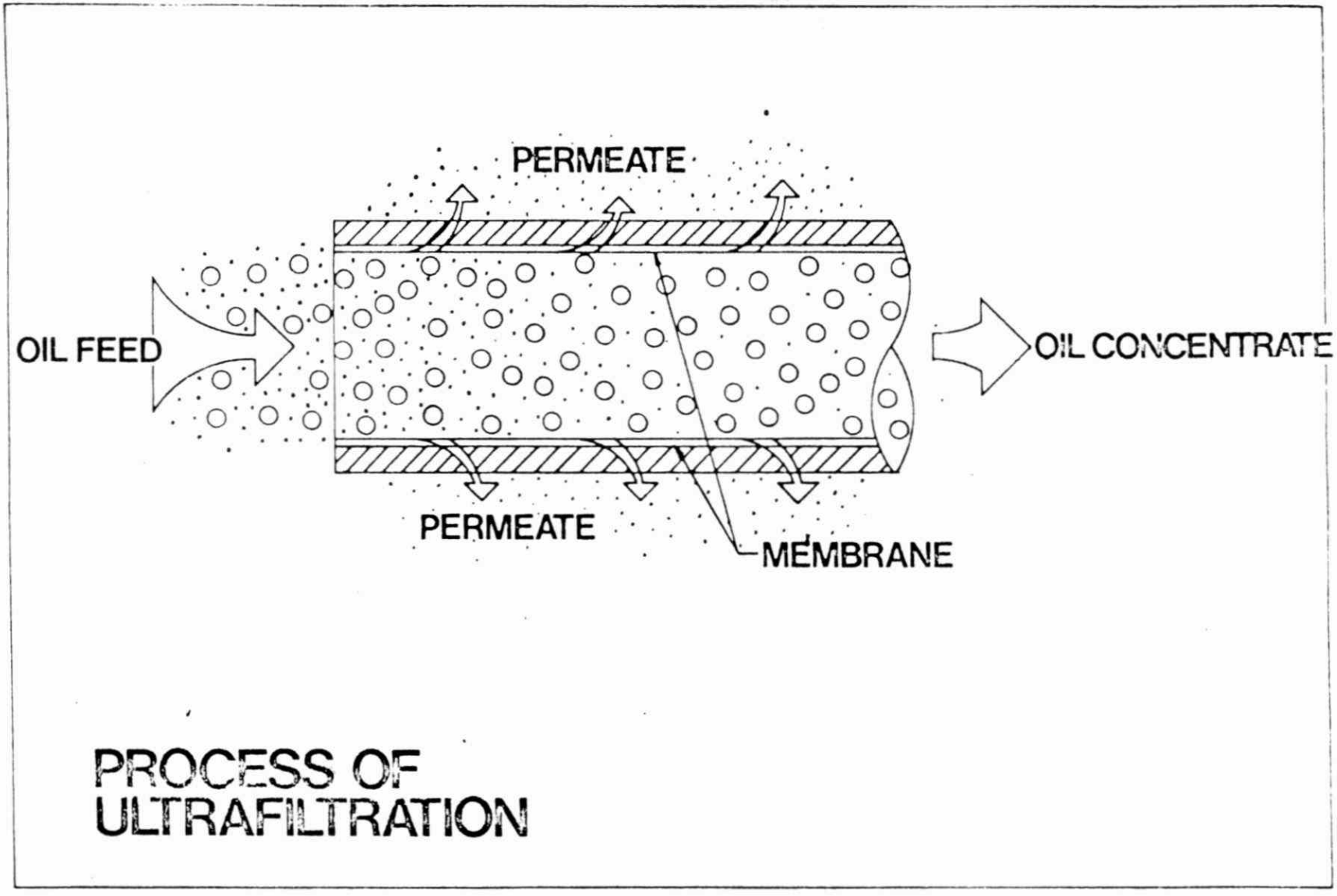

PERMEATE
OIL FEED
OIL CONCENTRATE
PERMEATE
MEMBRANE
PROCESS OF
ULTRAFILTRATION

FIGURE 3

INDUSTRIAL APPLICATIONS

There is a wide range of applications in industry where ultrafiltration has been proven and is being proven to be a viable alternative for pollution control and product recovery.

Oil/Water Emulsions

Oil/water emulsions are commonly used in the metal stamping, machining and rolling operations. The most common application is in the parts washer. Here the various parts are generally washed with a hot alkaline detergent solution. It is this process which strips the oil from the parts. This process continues to increase the oil concentration in the washer as more and more parts are washed. Due to this increase in oil concentration, the effectiveness of the washer (the ability of the washer to strip the oil from the parts being washed) decreases to the point at which the oil concentration reaches a level (about 5%) where cleaning ability of the washer is no longer acceptable.

It is at this point (usually once per week), the washer solution must be dumped, cleaned and refilled with fresh water and chemicals. This procedure not only requires additional labour, chemicals and downtime but also the problem of disposing of a quantity of 1,000 to 10,000 gallons of a 5 - 10% oil emulsion solution.

The costs of disposal for the oil/water emulsion are expensive due to the high costs of trucking and treatment of the emulsion for disposal. Zenon's ultrafiltration systems have shown to dewater the oil water emulsion to allow one or more of the following:

(1) Recovers oil for reuse.

(2) Removal of up to 95% of the water content.

(3) Recycling of the permeate water.

(4) Incineration of the oil concentrate.

(5) Substantial reductions in disposal costs.

(6) Elimination of cleaning and downtime of the washer.

Generally there are two methods of treating oil emulsions by ultrafiltration.

The first method as shown in Figure 4 is called "The Continuous Concentration - Closed Loop System". In this method, the ultrafiltration system is fed from the parts washer at a rate equal to the rate at which the permeate is returned to the washer and the rate at which the concentrated "split" oil is removed.

The oil breaks or splits in the process tank and floats to the top and is skimmed off. The reasons for the emulsion breaking is the lower stability at a pH adjusted process of 6.5 - 7.0, and the removal of stabilizing surfactants into the permeate stream. Table 1 compares the reclaimed oil to the original oil specifications.

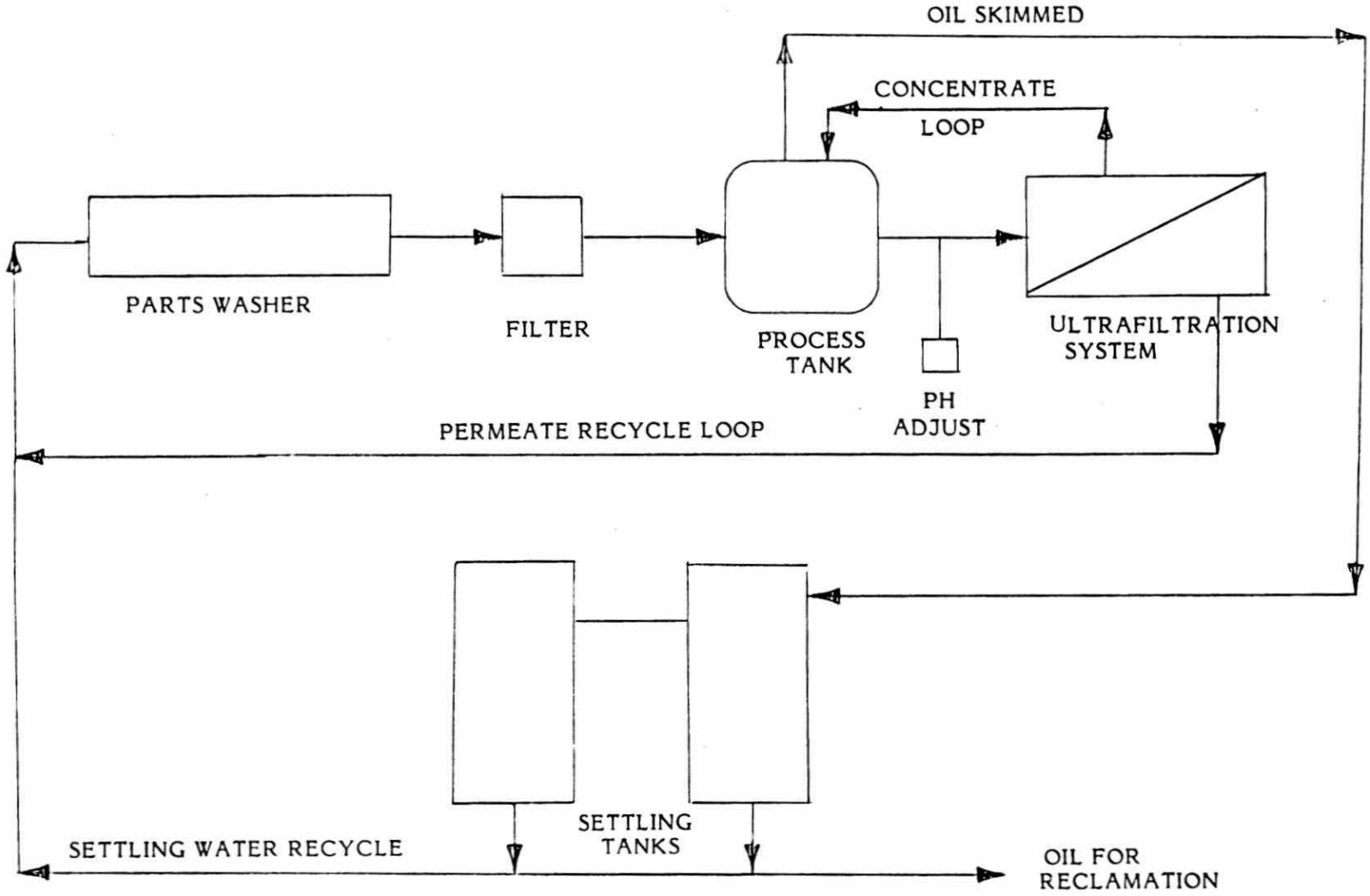


FIGURE 4

FLOW DIAGRAM FOR OIL RECOVERY IN A

CONTINUOUS CONCENTRATION - CLOSED LOOP SYSTEM

TABLE 1

	ORIGINAL OIL	RECLAIMED OIL
Appearance	Dark	Dark Opaque
Copper Corrosion	Nil	Nil
Viscosity, SUS (at 100°F)	2250	850
Rust Protection, hours	200	50
Specific Gravity (at 60°F)	1.070	0.966
Sludge, Metal Finis (percent weight)	0.0	<0.1

The reclaimed oil is processed for reuse. This process keeps the washer oil concentration at a level of 0.50 - 0.75 (percent by weight), and the concentration in the Ultrafiltration system reaches an equilibrium concentration of 8 - 10 oil (percent by weight). Figure 5 shows the typical performance of such a system and Table 2 shows the economics for a 1000 gallons per day system.

FIGURE 5

System Performance

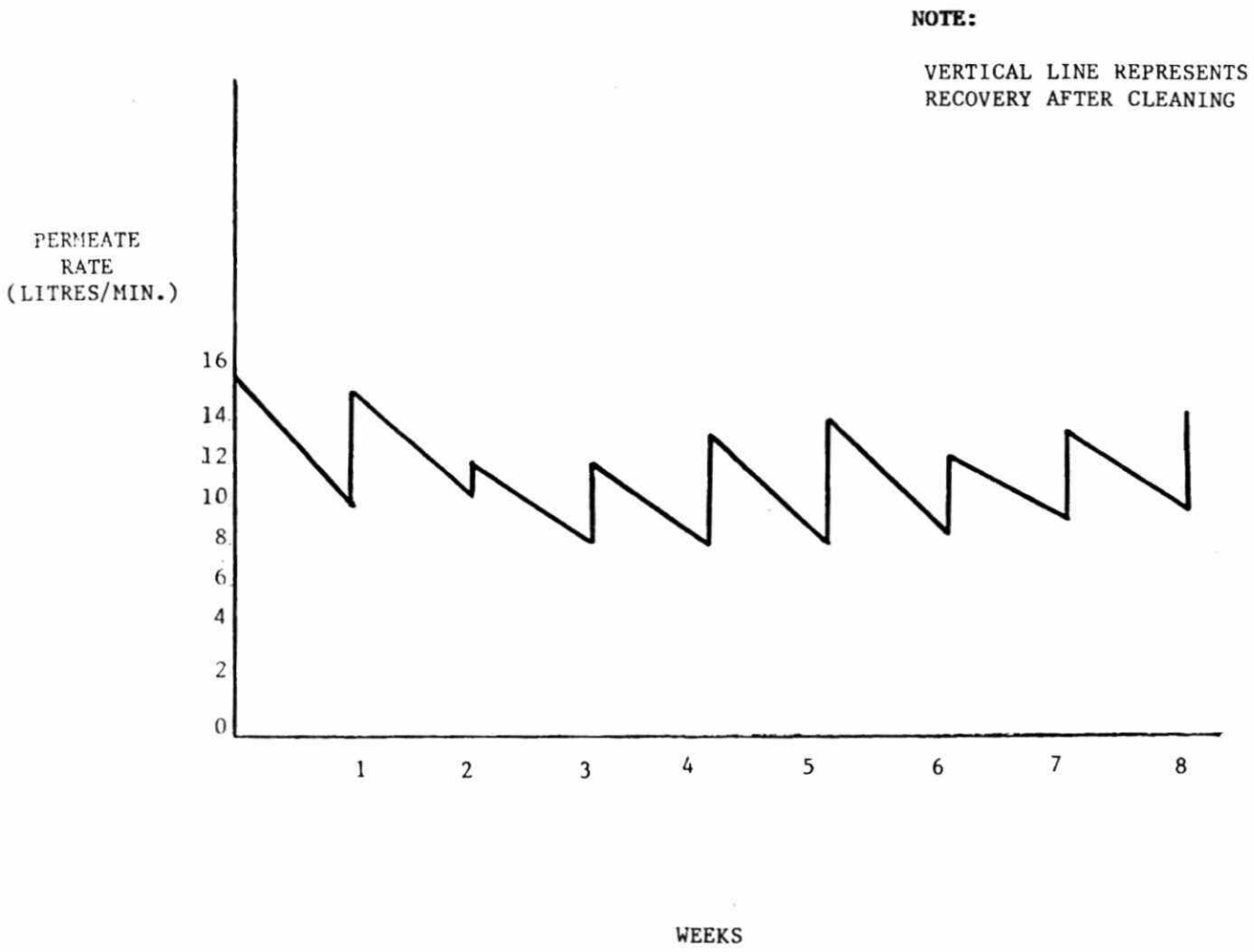


TABLE 2

Economics For a 1000 Gallon/Day System
For Ultrafiltration of Oil Emulsions

OPERATING COSTS DESCRIPTION	COST PER YEAR
Membrane Replacement	$ 3,990.00
Electricity (3.5 cents/KwHr)	1,370.00
Cleaning Solution	1,012.00
Miscellaneous Items	990.00
Labour (1 hr./day @ $11/hr)	4,015.00
TOTAL	$ 11,377.00

PAYBACK CALCULATIONS	PER YEAR
Capital Costs	$ 33,000.00
Volume Reduction (195 operating days)	175,500.00 gal
Disposal Savings (40 cents/gallon)	70,200.00
Annual Operating Costs	11,377.00
GROSS SAVINGS	$ 68,823.00
Capital Cost Allowance (50%/year)	$ 16,500.00
Taxable Savings	52,323.00
Corporate Income Tax Payable (45%)	23,545.00
NET AFTER TAX SAVINGS	$ 28,778.00

Payback 1.15 years

The second method of concentrating oil emulsions, is the batch method and, in these cases, the oil is not reclaimed but the disposal costs are reduced by a factor of up to fifteen.

There are numerous industrial applications where ultrafiltration is employed. Ultrafiltration is used for the concentration of latex washwater, and in the electrodeposition paint process for paint recovery, for pulp and paper sulphate and sulphite process water, the removal of colloidal material in wash water, recovery of coal and water from coal tailings and the recovery of metal complexes in the plating industry.

Textile Industry

Large volumes of wastewater containing fibres and dying material are produced in various processes in the textile industry. Ultrafiltration has been demonstrated highly efficient in removing pollutants from textile wastewaters as shown in Table 3.

Ultrafiltration has also been effectively demonstrated in recycling the synthetic sizing agents such as sodium carboxymethylcellulose (CMC) and polyvinyl alcohol (PVA). This recycling has eliminated the high BOD levels of the wastestream and recovered expensive materials.

TABLE 3

Pollutant Removal Efficiencies of Different Treatment Methods Applied to Textile Wastewater (Percent Removal)

	BIOLOGICAL	ALUM COAGULATION	CARBON ADSORPTION	MEMBRANE SYSTEMS
BOD	70 - 95%	50 - 70%	60 - 95%	80 - 98%
COD	30 - 70%	50 - 70%	60 - 95%	80 - 98%
SOLIDS				
TOTAL	5 - 10%	5%	10 - 30%	70 - 98%
VOLATILE	10 - 50%	50%	50 - 80%	75 - 98%
SUSPENDED	30 - 90%	80 - 90%	60 - 90%	95 - 100%
COLOUR	10 - 80%	80 - 90%	80 - 98%	95 - 100%
ALKALINITY	10 - 20%	0 - 20%	5%	80 - 95%

Source: "Waste Treatment Versus Waste Recovery". Textile Chemist and Clourist, November, 1977.

FOOD PROCESSING EFFLUENTS

Food processing annually produces billions of gallons of wastewater every year. These wastestreams contain high levels of BOD, solids and lost valuable components. Typical examples exist in the cheese processing and fish processing industries.

Cheese Whey

For every pound of cheese made nine pounds of cheese whey is produced. More than 45 billion pounds of cheese whey is produced every year in North America. This whey contains more than 2 billion pounds of lactose, 345 million pounds of protein and large amounts of water soluble vitamins.

Cheese whey is no longer considered a wastestream but a product which can be further processed to produce animal food supplement, USP lactose, a skim milk replacer, various bakery products, dietary products, baby food, industrial grade alcohol and methane.

As shown in Figure 6 for the processes for alcohol lactose and syrup production, it is demonstrated that ultrafiltration is required to obtain the required separation and concentration. This combined with additional processes convert the whey into the desired end product.

An additional procedure is to preconcentrate by ultrafiltration the milk prior to producing camembert, feta and low-fat semi-hard cheeses. This results in a 30% increase in yield and the corresponding decrease in the amount of cheese whey produced. Table 4 shows the typical analysis of cheese whey concentrated by ultrafiltration.

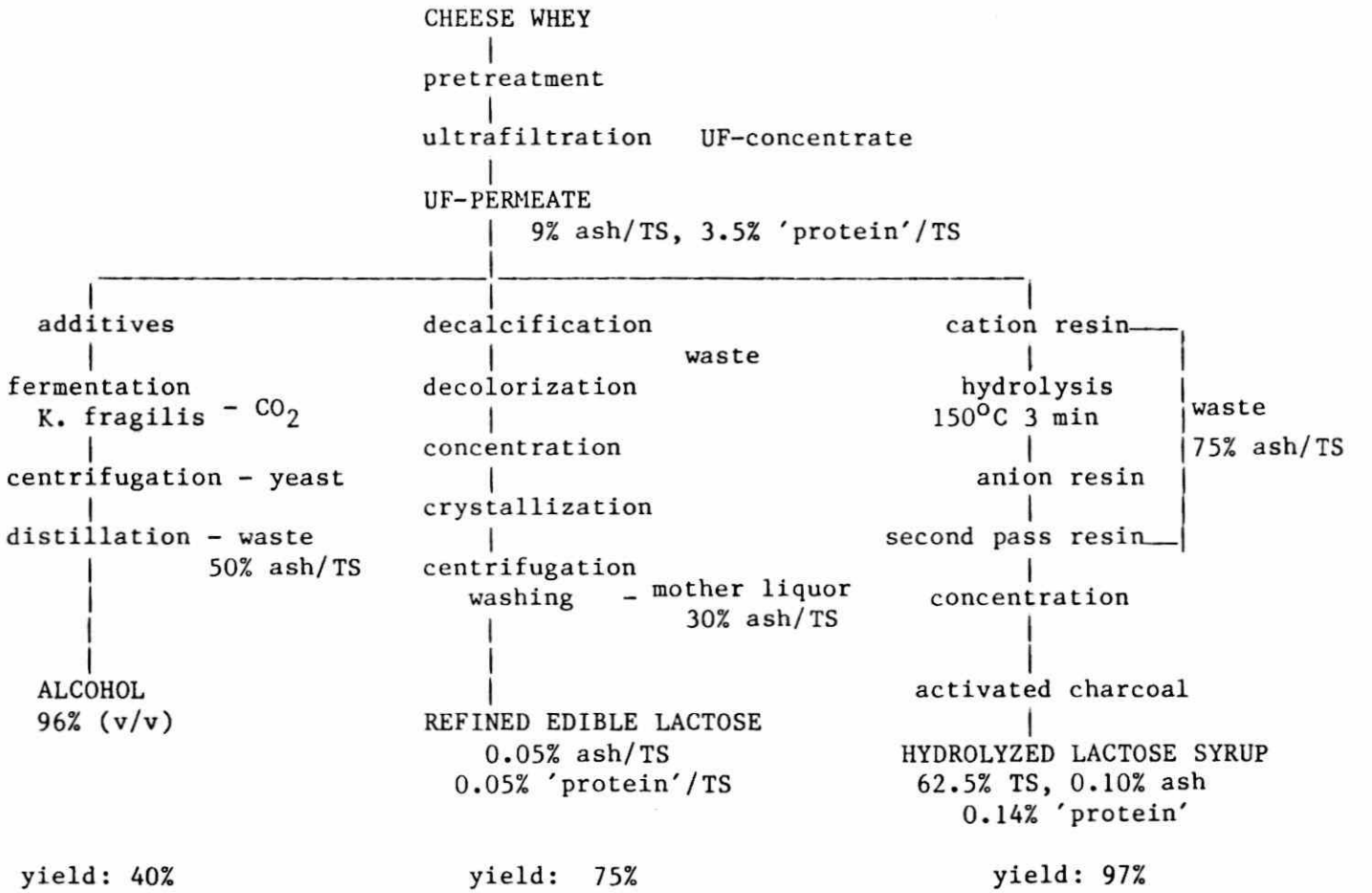
TABLE 4

Typical Cheese Whey Data

	TOTAL TS SOLIDS	PROTEIN	ASH	FAT	LACTOSE
FEED	7.01	0.83	0.61	0.25	5.32
CONENTRATE	27	15.0	0.97	3.2	7.8
PERMEATE	7.78	-	0.52	-	7.26

FIGURE 6

The Processing of Ultrafiltration Permeate Into Three Purified Products



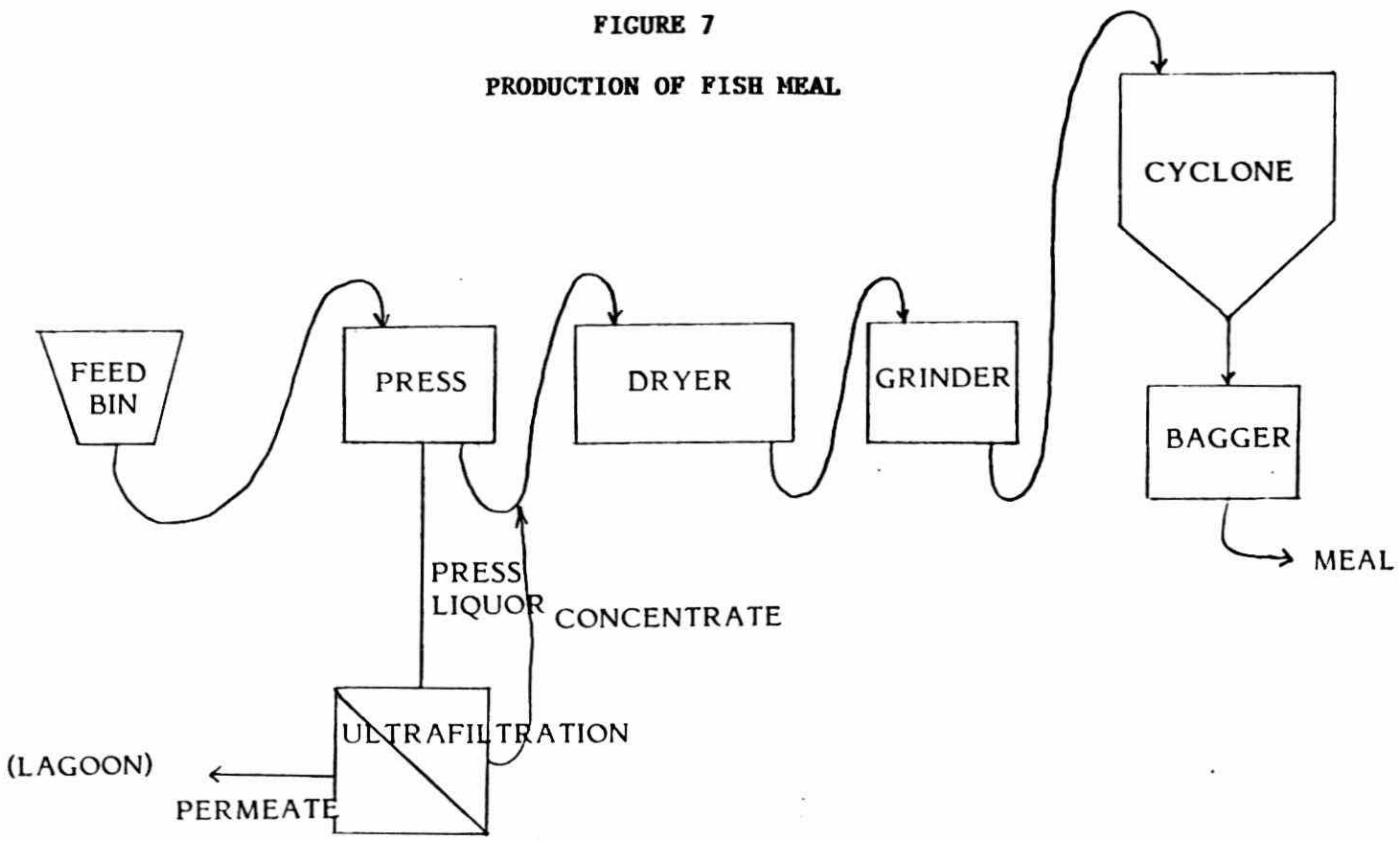
Fish Processing Effluents

Fish processing plants produce large volumes of wastes which contain high levels of proteinaceous material, water and oil. Disposal is a problem due to the high levels of BOD and solids.

This waste which contains about 68% moisture is used in the production of fish meal for animal feed. In the manufacture of fish meal a wastestream is produced, called fish stick water. The process shown in Figure 7 illustrates the various stages.

FIGURE 7

PRODUCTION OF FISH MEAL



Ultrafiltration has been shown to be effective in reducing the wastestream BOD levels and recovering valuable proteins. Typical results are shown in Table 5.

TABLE 5

Analysis of Ultrafiltration Streams

	OIL (mg/L)	BOD_5 (mg/L)	SUSPENDED SOLIDS (mg/L)
UF PERMEATE	8,200	13,000	170
UF CONCENTRATE	42,000	142,000	76,100

There are numerous other cases where Ultrafiltration has been shown useful for the treatment of waste effluents produced in the food industry. Additional examples exist in the production and purification of soya bean oil, recovery of starch from rinsewater and fruit processing.

CONCLUSIONS

Ultrafiltration membrane processes can not only recover valuable components in the liquid waste stream and reduce or eliminate the disposal/pollution aspect but can economically be justified over a short period of time. In addition, ultrafiltration may be employed in processing steps to increase the product yield and decrease the quantity of liquid wastewater.

Ultrafiltration will play an ever increasing role in industry. Not as a pollution control step but as a process stage in the manufacturing process.

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RELATIONSHIP OF SUSPENDED SOLIDS TO pH

pH	Suspended Solids ($mg/L \times 10^3$)
12.37	4.09
11.88	2.69
10.58	2.31
9.16	1.41
8.08	1.03
6.11	1.26
5.50	2.07
4.01	7.21
3.17	13.73

Suspended solids were measured according to Standard Method on various pH adjusted (with 1M NaOH) soap stock solutions.

WASTEWATER TREATMENT ALTERNATIVES FOR USED METALWORKING FLUIDS

by

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Cincinnati Milacron
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ABSTRACT

Water-based metalworking fluids have been used for years as an inexpensive method to improve machining and grinding metalworking performance. However, fluid purchase, use, and disposal costs have increased to the point where many plants are challenging their current fluid use practices.

Metalworking plants, through careful fluid selection, control, and disposal, can maximize fluid performance while minimizing fluid costs. This paper discusses fluid management practices and wastewater treatment alternatives with the objective of improving the use of fluids in metalworking plants.

There are two environmentally safe and cost effective ways to treat fluids for sewer discharge: ultrafiltration and chemical treatment. Fluid recycling can be used by many plants to reduce the need for disposal or wastewater treatment and, at the same time, generate fluid concentrate cost savings.

INTRODUCTION

For many years, metalworking fluids have been used to increase the productivity of machining and grinding operations. Oil-water emulsions provide benefits of both lubricity (for reduction of friction) and cooling (for reduction of heat) in the machining or grinding process. In the past these fluids have been relatively inexpensive to purchase, use, and dispose. More recently, fluid costs have rapidly increased. Many metalworking plants are now investigating alternative processes to better manage the use and disposal of metalworking fluids.

This paper suggests ways plants can improve productivity while lowering fluid costs through improved fluid management and waste treatment practices.

PAST PRACTICES

In the past, direct sewer discharge and contract hauling were common methods for disposing of used fluids. The environmental legislation of the early 1970's required better treatment for used oily wastewater. Environmental legislation in the early 1980's has placed strict limitations on landfilling wastes. Contract hauling prices have rapidly increased due to the treatment and reporting requirements for used oily wastewater disposal.

The high contract hauling prices or the limited availability of contract hauling has forced many metalworking plants to consider alternative wastewater treatment methods.

FLUID MANAGEMENT PRACTICES

As fluid costs increase, metalworking plants seek improvements in fluid management practices.

The first area to investigate is fluid selection practices. Many fluid criteria are studied during the selection process. Some of these are:

* cost (overall)
* performance
* ease of waste treatment
* effect on operator's health and safety
* overall service support from supplier

In addition, the specific application must consider:

* operation (type of machining or grinding, process rates)
* type of metal
* machine type and condition
* part requirements (tolerances, finish, etc.)
* central system versus individual machine tool.

Typically, the fluid selection process involves a fluid cost versus benefit analysis. It is important to study the overall fluid cost, not just the purchase price. Therefore, to look at the overall fluid cost, investigate the following costs:

* purchase price
* labor (mixing, transporting, and controlling)
* machine downtime (for charging and disposing of fluid)
* waste treatment
* operator environment (safety and health)

Also, fluids must be selected with overall plant needs in mind. Close cooperation is needed between the purchasing, laboratory, production, and waste treatment personnel to obtain the best overall fluid for the plant.

STRAIGHT OIL, SOLUBLE OIL, SEMISYNTHETIC, AND SYNTHETIC

The fluid selection process invariably involves a discussion of fluid types, the advantages and disadvantages of each type. Though industry terminology on fluid types is not universal, there are four distinct fluid classes. These are straight oil, soluble oil, semisynthetic, and synthetic. The straight oil contains no water, while the synthetic

fluid contains no oil. The soluble oil and semisynthetic are oil-water emulsion products. The soluble oil contains a high percentage of oil in the concentrate, while the semisynthetic fluid contains a lower quantity of oil in the fluid concentrate.

It is difficult to generalize concerning the performance characteristics of the various fluid types. However, the synthetic and semisynthetic products offer plants a cleaner environment and good long-term performance. Soluble oils provide good lubricity for heavy-duty applications. In the final analysis, no fluid is perfect. Once the fluid selection criteria are specified, thorough laboratory, production, and waste treatment tests are needed to select the best product.

WASTEWATER TREATMENT ALTERNATIVES

In addition to the fluid selection process, it is important for a plant to consider various wastewater treatment alternatives in order to minimize fluid disposal costs. The major wastewater treatment alternatives available for metalworking plants are:

1. contract hauling
2. chemical treatment
3. ultrafiltration
4. fluid recycling

Metalworking fluids that provide a long life will minimize waste treatment. As a general rule, plants that use metalworking fluids must treat the used fluids prior to sewer discharge or pay for contract hauling services.

Certain plants that generate a very low volume of used fluids may receive special permission from a municipal treatment plant for direct sewer discharge. Typically, simple pretreatment is required to remove tramp oil and solids prior to sewer discharge. Dilution of fluids with the purpose of meeting sewer discharge standards is generally not permitted.

CONTRACT HAULING

Contract hauling of fluids is performed by companies which pump out and haul fluids from metalworking plants. The contract hauler treats and disposes of the used fluids for a fee charged to the plant.

Contract hauling is used by many plants where the low volume of fluid generated does not justify the installation of wastewater treatment equipment. In many cases, contract haulers offer a valuable service to plants.

Of course, it is important for the contract hauler to provide reputable service, where fluids are treated for environmental disposal. Due to many of the requirements of the Resource Conservation and Recovery Act (enacted in 1979), the cost of contract hauling has rapidly increased. Many metalworking plants are currently investigating alternative waste treatment or disposal methods.

CHEMICAL TREATMENT

Chemical treatment uses various inorganic (Alum, Ferric Chloride, Ferric Sulfate, Calcium Chloride, Lime, etc.) and organic (polymers) chemicals to "break" a used oil-water emulsion. The emulsion is separated into two distinct phases, the water and oil-sludge phase. After treatment and sufficient settling time, the water phase is drained to the sewer. The oil-sludge requires further treatment for dewatering and land disposal.

Chemical treatment is the most common treatment method for used metalworking fluids. This process can be adapted to many different types and quantities of wastewater. Metalworking plants use chemical treatment for wastewater volumes ranging from several hundred gallons to hundreds of thousands of gallons/day. As the volume to be treated increases, the chemical treatment cost per gallon decreases. For most chemical treatment plants, used metalworking fluids comprise less than 20 percent of the wastewater to be treated. The chemical treatment process is used for both batch and continuous type treatment systems (see FIGURES 1 and 2).

Typically, chemical treatment equipment includes free oil removal equipment (API separators, belt or rope skimmers, coalescers, etc.), chemical mixing equipment (tanks, pumps, flow meters, mixers, etc.), settling tanks, as well as any needed post treatment equipment. Full instrumentation and automation is included in many of the larger plants.

Treatability studies are completed on any new metalworking products prior to their use in a plant. The treatability studies typically use jar testing in order to define the optimum chemical dosages and treatment procedure for the best chemical "break." Though jar tests are not always predictive of the large scale batch or continuous treatment process, they are the best available resource for many plants. Pilot systems, which are small versions of the actual treatment plant, are useful when accurate studies are needed.

The goal of chemical treatment for used metalworking fluids is to "break" the oil-water emulsion. The ideal fluid from a chemical waste treatment viewpoint is one that is easily broken. In many cases this "ideal" is in direct opposition to the formulator's goal of creating a long lasting and stable product.

The ability to successfully "break" a used fluid to meet sewer discharge standards is dependent on several variables. Among these variables are:

* type of fluid being treated (soluble oil, synthetic, etc.)
* emulsifiers and other chemical components in the fluid (anionics, nonionics, cationics, cleaning agents, anti-foam agents, etc.)
* type of treatment process or equipment (batch vs. continuous, aeration vs. paddle wheels, etc.)
* type of treatment chemicals used (Alum, Ferric Chloride, polymers, etc.)

* characteristics of the wastewater treatment process (wastewater composition, concentration of chemicals, mix time, temperature, flow rate, etc.)
* limitations on chemical treatment process (types of chemicals used, quantity of chemical dosages, treatment rates, etc.)

A chemical treatment process may work very well for one type of fluid and be inadequate to treat other types of fluids. Careful study is required to define the effect on the chemical treatment process when changing from one fluid to another.

A precise study may be difficult to complete due to the wide variations in the volume of used fluids discharged to chemical treatment plants. For instance, in a plant where a central system has been charged with one fluid for several years, the "dump" or discharge of the entire central system at one time to waste treatment will require special attention at the waste treatment plant to adequately treat this batch or volume of fluid.

Sewer discharge standards restrict quantities of Oil & Grease, Total Suspended Solids, Chemical Oxygen Demand (COD), or Biochemical Oxygen Demand (BOD), and the pH level that can be discharged to a municipal treatment plant. Stream discharge standards are much more restrictive and are generally set by the State and regulated through a permit system (NPDES). The standards vary some from one area to the next. In addition, the enforcement of the standards may also vary.

With good fluid management, the overall impact of the fluid is considered Production benefits are weighed against waste treatment costs. One area of particular concern for many chemical treatment plants is the reduction of COD. Most metalworking fluids have high COD's due to the type and quantity of organic material (and oxidizable inorganics) in these products. Refer to Table I for a list of several different products and their COD values.

The commodity soluble oil is the least expensive product and would provide the shortest life. In the concentrate form it has a very high COD, however, after use and chemical treatment it has the lowest COD value for any of the listed products.

The synthetic fluid concentrate has a much lower COD than the commodity soluble oil and would be expected to give the longest life. However, the COD reduction as a result of chemical treatment is low. Therefore, the effluent COD is high in comparison to the commodity soluble oil effluent.

Table II takes the COD analysis one step further. The overall impact of COD discharge is investigated for the different products. The table points out that disposal, frequency, carryoff contribution factors, as well as chemical treatment costs, all contribute to the "overall treatment cost factor." Disposal frequency, effluent COD, as well as the contribution factor for fluid carryoff are the factors that contribute to the "overall COD contribution factor."

The various numbers listed in Table II are typical values for the different types of fluids. They are listed merely as guidelines in order for plants to consider the overall impact of chemical treatment costs and COD contribution factors. Certainly there are no fixed rules regarding the specific fluids to be used. Each fluid must be tested with respect to the plant and chemical wastewater treatment plant in question.

In summary, chemical treatment is a widely used and effective process to treat oily wastewater for sewer discharge. The chemical treatment provides metalworking plants the required treatment for sewer discharge, and reduces dependence on contract hauling.

ULTRAFILTRATION (UF)

Ultrafiltration (UF) is a physical treatment process where a semipermeable membrane is used to separate oil and large molecular substances from a used oily wastewater. The treated effluent, or permeate, from an ultrafiltration process is generally of acceptable quality for direct sewer discharge. Figure III depicts a typical UF process.

The UF process typically concentrates an oily wastewater 90-95 percent by volume. The remaining 5-10 percent volume is an oily concentrate (typically contains 30-50 percent oil) which is contract hauled, incinerated, or treated for oil recovery. There are many advantages of the UF process compared to chemical treatment. First of all, since UF is a physical treatment process, the variability of effluent quality in a chemical treatment process is eliminated. The UF permeate is consistently of high quality. The oily concentrate is more easily treated or disposed compared to the chemical sludge from the chemical treatment process. Oil-water emulsions are effectively treated by UF since the separation of the oil from water is a physical separation process and does not rely on the emulsion chemistry. Also, UF is less expensive than chemical treatment and contract hauling for plants needing to treat approximately 100 gallons per day up to 50,000 gallons per day.

A typical UF membrane provides separation based on a .007 micron pore size. The molecular weight cutoff for this membrane is 50.000. The feed pressure required for the membrane is 25 psig. Turbulent flow is maintained throughout the membrane surface to maximize effluent flow rates. When flow rates decline to a predetermined level, the membranes are cleaned and backflushed to regenerate initial flow rates. Typically the membranes provide good service for 2-3 years.

In summary, the UF process offers plants the advantage of simplicity, low operating and capital costs, effective treatment of metalworking fluids for sewer discharge, and an oily concentrate acceptable for further treatment for oil recovery. Metalworking plants currently contract hauling their oily wastewater most likely will benefit from using UF treatment due to in-plant control of wastewater treatment and cost savings (compared to contract hauling). In several plants, the UF process is followed by activated carbon or reverse osmosis treatment to permit stream discharge or reuse of the effluent.

METALWORKING FLUID RECYCLING

Of all the fluid management alternatives, recycling is the ultimate in good management since this provides overall in-plant controls of fluids to permit reuse. Plants can reduce fluid use costs, namely fluid concentrate and waste treatment costs through effective fluid recycling. Though fluid recycling can be loosely defined as extending fluid life, the typical objectives of fluid recycling are to:

* extend fluid life
* improve fluid productivity
* improve in-plant environment for operators
* reduce waste treatment costs
* recover tramp oil

NEEDS FOR RECYCLING

To effectively recycle metalworking fluids it is important to employ the following:

1. EFFECTIVE FLUID MANAGEMENT

   Good fluid management maximizes fluid performance and minimizes costs. Fluid selection criteria, fluid testing, fluid control tests, fluid maintenance, etc., are necessary for good fluid management. Ideally one group of people or one individual has overall responsibility for fluids. This individual or group will need to communicate with purchasing, production, maintenance, the laboratory, and waste treatment to maintain good control over the fluids.

2. PREMIUM FLUIDS

   To maximize fluid life, a premium fluid must be used. A premium fluid contains effective bactericides and fungicides, rust inhibitors, cleaning agents, and stable emulsifiers.

3. MINIMUM NUMBER OF FLUID TYPES

   Effective fluid recycling becomes increasingly difficult as the number of different fluids used increase. For example, in plants that use a large number of fluids it is not unusual for mistakes (such as mixing two different products together) to occur.

   In most plants, three fluid types or less will meet all plant needs.

4. GOOD WATER QUALITY

   The quality of the water mixed with metalworking fluid concentrates is very important to the performance of these fluids. Fluid life, tool life, part finish, foam characteristics, product residue, part or machine corrosion, bacterial control, mold growth, and concentrate usage are all affected by water quality.

During normal fluid use, evaporation and carryoff losses require daily additions of fluid makeup. This process increases the quantity of total dissolved solids (TDS) in the fluid. Figure IV depicts the theoretical increase in total dissolved solids due to evaporation losses and 10 percent daily makeup. The higher the initial TDS of the water source the more rapid the TDS increase with time. As certain dissolved solids increase in quantity, problems may develop with the fluids. For instance, mineral and hardness salts, particularly chlorides and sulfates, contribute to corrosion at a level of approximately 100 ppm. Sulfates also promote the growth of sulfate reducing bacteria in fluids which create a "rotten egg" odor.

It is important to have a water analysis of the plant's water. If the water quality is poor (150 ppm hardness or higher), deionized water is recommended. Deionization removes both the anions (chlorides, sulfates, nitrates, phosphates, etc.) and cations (calcium, magnesium, sodium, iron, etc.) from the water. Deionized water can provide many benefits for the performance of metalworking fluids. However, the benefits of deionized water in terms of improved fluid performance must be weighed against the cost of obtaining DI water. Water softening is not the same as deionization and may actually create problems with metalworking fluid performance.

RECYCLING-CENTRAL SYSTEMS

A central system is a large fluid reservoir which supplies fluid to several individual machine tools. Plants where many individual machines perform similar operations are well suited to central systems. The advantage of a central system is that the fluid is maintained in a good condition as a result of the central system's filtration. In addition, daily fluid checks for pH, fluid concentration, tramp oil, total oil, dirt, bacteria, and mold can be completed for the fluid in a central system in order to maintain the fluid in good condition. With proper fluid controls, it is not unusual for a fluid to last several years in a central system.

Typical types of contaminant removal systems for central systems are listed in Table III. Normally, central systems are equipped with filtration (paper or cloth media, wire screens, diatomaceous earth, etc.) to remove particulates. Equipment, such as centrifuges or coalescers, may be added to the central system to control tramp oil contamination.

RECYCLING - INDIVIDUAL MACHINES

Metalworking fluids used in individual machine tool sumps normally have a shorter life than fluids in central systems. Because of the many different machine sumps, different fluids, and different fluid concentrations, the fluid control practices for individual machine tools are more difficult than with central systems. Typically, fluid concentration checks are not completed on a scheduled basis for fluids from individual machine sumps. In many cases, the individual sumps have no equipment to remove contaminants such as dirt and oil. Consequently, the normal practice is to use the fluid until obvious problem, such as dirty appearance or offensive odor occurs. At that time the fluid is dumped and recharged.

Significant cost savings and fluid performance improvements are available to plants if a metalworking fluid management system is used to recycle fluids for individual machine tools.

PLANT SURVEY

To determine the benefits of a fluid recycling program for a plant with numerous individual machine tools, a fluid survey is recommended. The survey is used to define types of fluid used, quantity of fluid purchased, quantity of fluid disposed, etc. The total savings available through fluid recycling can be predicted with the fluid survey data. An example of a plant survey data form is found in Table IV.

SELECTION OF RECYCLING EQUIPMENT

It is important to specify a plant's objectives for metalworking fluid recycling. Then it is important to specify equipment criteria needed to meet these objectives.

Examples of plant objectives in a fluid recycling program are:

* extend fluid life
* reduce fluid costs
* reduce wastewater treatment volume
* improve fluid performance
* improve operator environment

Examples of equipment selection criteria for a fluid recycling system are:

* rapid payback, high return on investment
* effective removal of oil, dirt, and bacteria
* simple operation
* minimal floor space requirement
* minimal maintenance required
* good service, warranty protection provided by supplier.

It is important for each plant to define its specific requirements for fluid recycling. Table V lists various types of equipment used with individual machine tools for removal of contaminants. Figure V depicts the various types of equipment.

While each of the previously listed pieces of equipment is effective, given the proper application, in many cases a combination of the individual equipment components provides a more effective system to control oil, dirt, and bacteria contamination.

FILTRATION/PASTEURIZATION/COALESCENCE

A combination of filtration, pasteurization, and coalescence has proven to be an effective and economical method to recycle fluids from individual machine tools. This equipment can be used to meet the needs of a wide

variety of metalworking plants and their fluids. This combination of fluid treatment equipment effectively removes contaminants from used fluids, while at the same time meets equipment selection criteria concerning costs, maintenance, and operation.

In the recycling process, a sump cleaner is used to transport the fluid and filter metal chips, swarf, and dirt from the used fluid. The used fluid is then pumped, using the sump cleaner, into the treatment module. The treatment module consists of a "dirty fluid" tank, the coalescer tank, and a "clean fluid" tank. The fluid in the used fluid tank is pumped through a circulation heater, raising the fluid temperature to 160°F. This is the temperature at which pasteurization kills most bacteria. By raising the fluid temperature, improved separation of tramp oil from the used fluid also occurs.

After passing through the heater, the fluid flows through the coalescer media. Coalescence combines small oil droplets into larger droplets which rise to the surface of the coalescer tank. A roll-type oil skimmer at the fluid surface removes the oil and deposits it in a 55-gallon drum. The clean fluid proceeds through the coalescer and is stored in the "clean fluid" tank. A concentration test is made to determine the need for addition of water or fluid concentrate to the clean fluid. New fluid mix is added to the clean tank to make up for fluid losses (evaporation and carryoff) during machining or grinding.

This equipment has benefits of:

* low payback - less than one year.
* good removal of contaminants - final oil level less than .5%, final dirt level less than 500 ppm; final bacteria level less than 100,000 counts/ml.
* simple operation - little operator training needed.
* minimal floor space - less than 100 sq. ft. required.
* low maintenance - coalescer media has no moving parts or replacement needed.

In summary, recycling provides benefits of improved fluid performance with lower fluid costs for plants using premium metalworking fluids with individual machine tools. In some plants, recycling has virtually eliminated the need for wastewater treatment of their metalworking fluids. Recycling is an excellent alternative to installation of wastewater treatment equipment for many plants.

SUMMARY

As metalworking fluid purchase, use, and disposal costs continue to increase, it is important for metalworking plants to consider improved metalworking fluid management techniques. Through careful fluid selection and improved wastewater disposal practices, plants can generate substantial cost savings. The primary alternatives to the expensive practice of contract hauling are chemical treatment, ultrafiltration, and fluid recycling.

Fluid recycling offers the greatest potential for improved fluid performance, cost savings, and reduced volume of wastewater produced.

TABLE I

CHEMICAL TREATMENT OF METALWORKING FLUIDS

FLUID TYPE	CHEMICAL OXYGEN DEMAND VALUES (mg/1)			
	FLUID CONCENTRATE	FLUID MIX	AFTER CHEMICAL TREATMENT	
Commodity Soluble Oil	2,214,880	110,740 (1:20)	1,107	(99% reduction)
Premium Soluble Oil	2,800,000	140,000 (1:20)	14,000	(99% reduction)
Premium Semisynthetic	525,000	17,500 (1:30)	3,500	(88% reduction)
Premium Synthetic	660,000	33,000 (1:20)	29,700	(10% reduction)

TABLE II

OVERALL COD DISCHARGE TO MUNICIPAL TREATMENT PLANTS

AS A RESULT OF METALWORKING FLUID DISCHARGE

FLUID	A ESTIMATED DISPOSAL FREQUENCY PER YEAR (TIMES)	B COD DISCHARGE OF EFFULENT AFTER CHEM. TREATMENT (mg/l)	C ESTIMATED CONTRIBUTION FACTOR FOR FLUID CARRYOFF TO WASTETREATMENT	D TOTAL FLUID USAGE (A x C)	E OVERALL COD CONTRIBUTION FACTOR FOR YEAR (B x D) (mg/l)	F CHEMICAL TREAT $ /GAL.	OVERALL TREATMENT COST FACTOR (D x F)
Commodity Soluble Oil	12	1,107	1.2	14.4	15,940.8	.10	$ 1.44
Premium Soluble Oil	2	14,000	1.2	2.4	33,600.0	.15	.36
Premium Semisynthetic	1	3,500	1.1	1.1	3,850.0	.18	.20
Premium Synthetic	1	29,700	1.0	1.0	29,700.0	.18	.18

TABLE III

CONTAMINANT REMOVAL EQUIPMENT

FOR CENTRAL SYSTEMS

EQUIPMENT	REMOVES		
	OIL	DIRT	BACTERIA
Settling/Dragout		X	
Multiple-Weir		X	
Flotation	X	X	
Positive Filters			
Gravity		X	
Pressure		X	
Vacuum		X	
Centrifuge	X	X	
Cyclone		X	
Coalescer	X	X	
Pasteurization			X

TABLE IV

METALWORKING FLUID MANAGEMENT SURVEY

DATA

Plant:
Manufacturer of:
Operations:
Metals:
Fluid Used:
Number of Machine Tools:
Average Sump Size:
Total Gallons of Fluid Purchased/Yr.:
Avg. Fluid Concentrate Cost/Gal.:
Cost of Waste Disposal/Gal.:
Equipment Burden Cost/Hr.:
Labor Burden Cost/Hr.:

PLANT SURVEY

MACHINE	DEPT.	FLUID	FLUID CONC.	SUMP CAPACITY	DISPOSAL FREQ./YR.	GALLONS DISPOSED/YR.

TABLE V

CONTAMINANT REMOVAL SYSTEMS

FOR INDIVIDUAL MACHINE TOOL SUMPS

MEDIA BASED SYSTEMS	REMOVERS		
	Oil	Dirt	Bacteria
Filtration		x	
Pressure		x	
Vacuum		x	
Gravity		x	
NATURAL FORCE SYSTEMS			
Settling/Gravity		x	
Oil Skimmers	x		
Coalescers	x	x	
Aeration	x		
MECHANICAL SEPARATION SYSTEMS			
Cyclones		x	
Centrifuges	x	x	
Magnetic Separator		x	
OTHER			
Pasturization			x

FIGURE I
BATCH CHEMICAL TREATMENT PROCESS

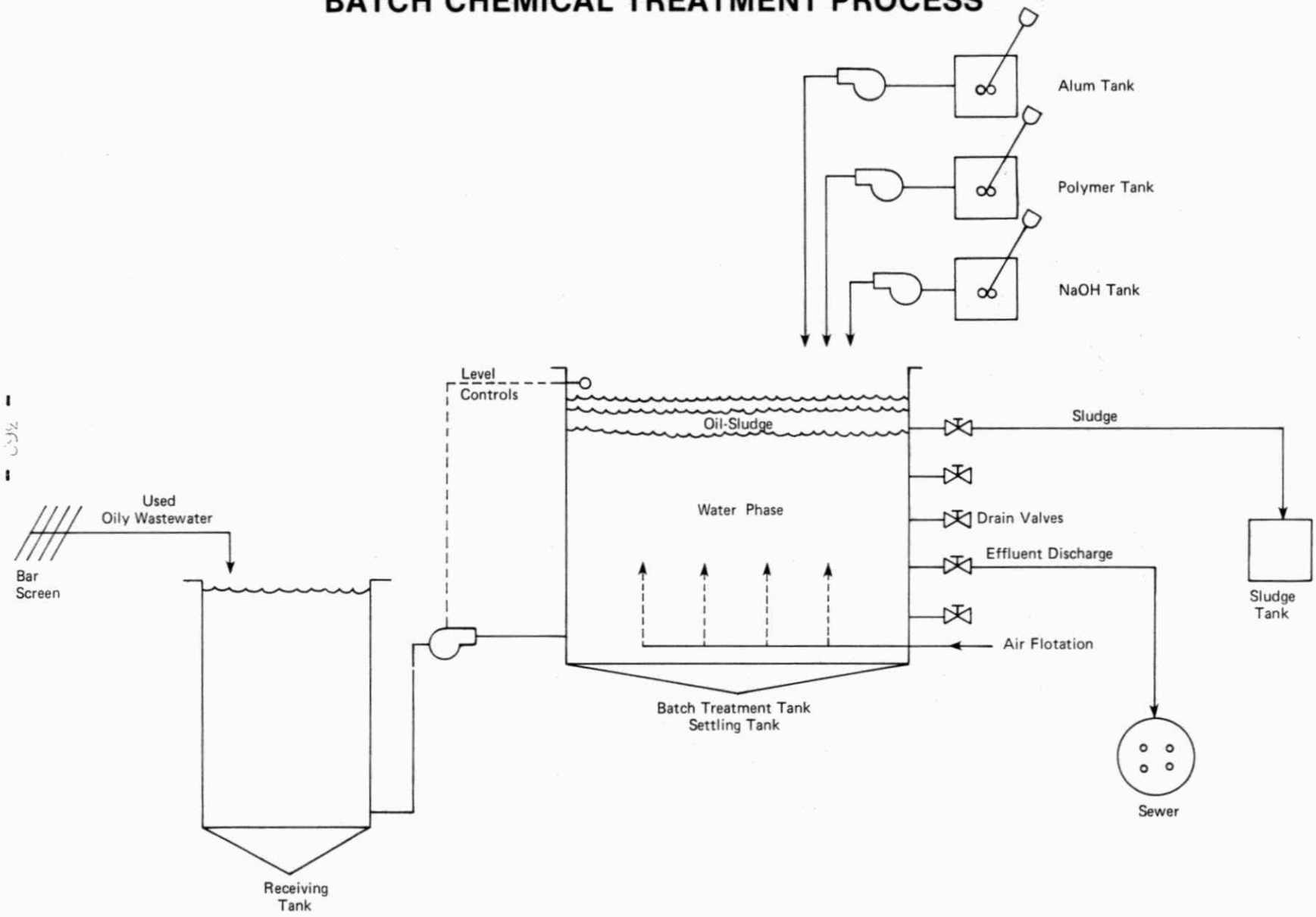


FIGURE II
CONTINUOUS CHEMICAL TREATMENT PROCESS

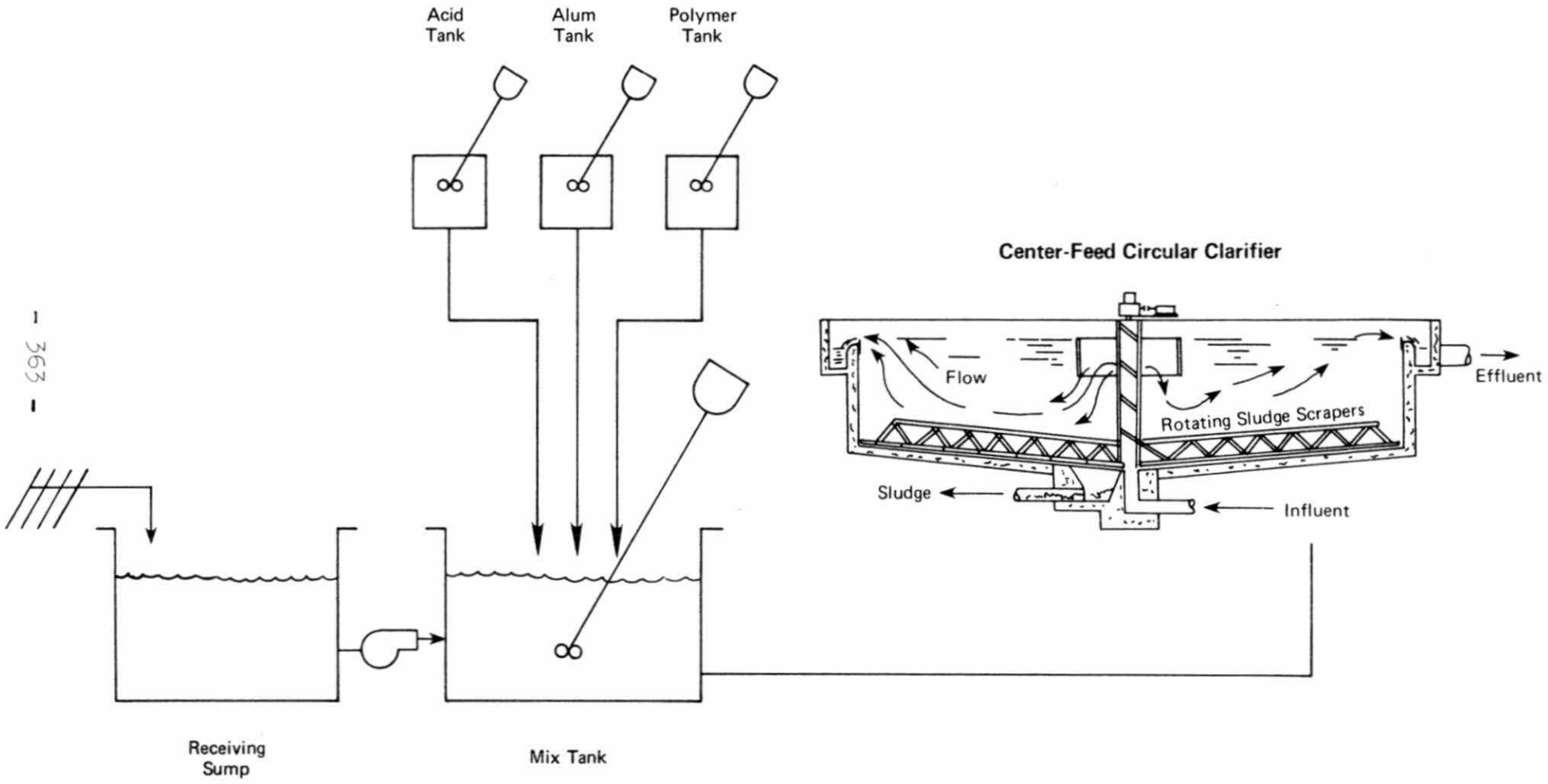


FIGURE III
ULTRAFILTRATION TREATMENT PROCESS

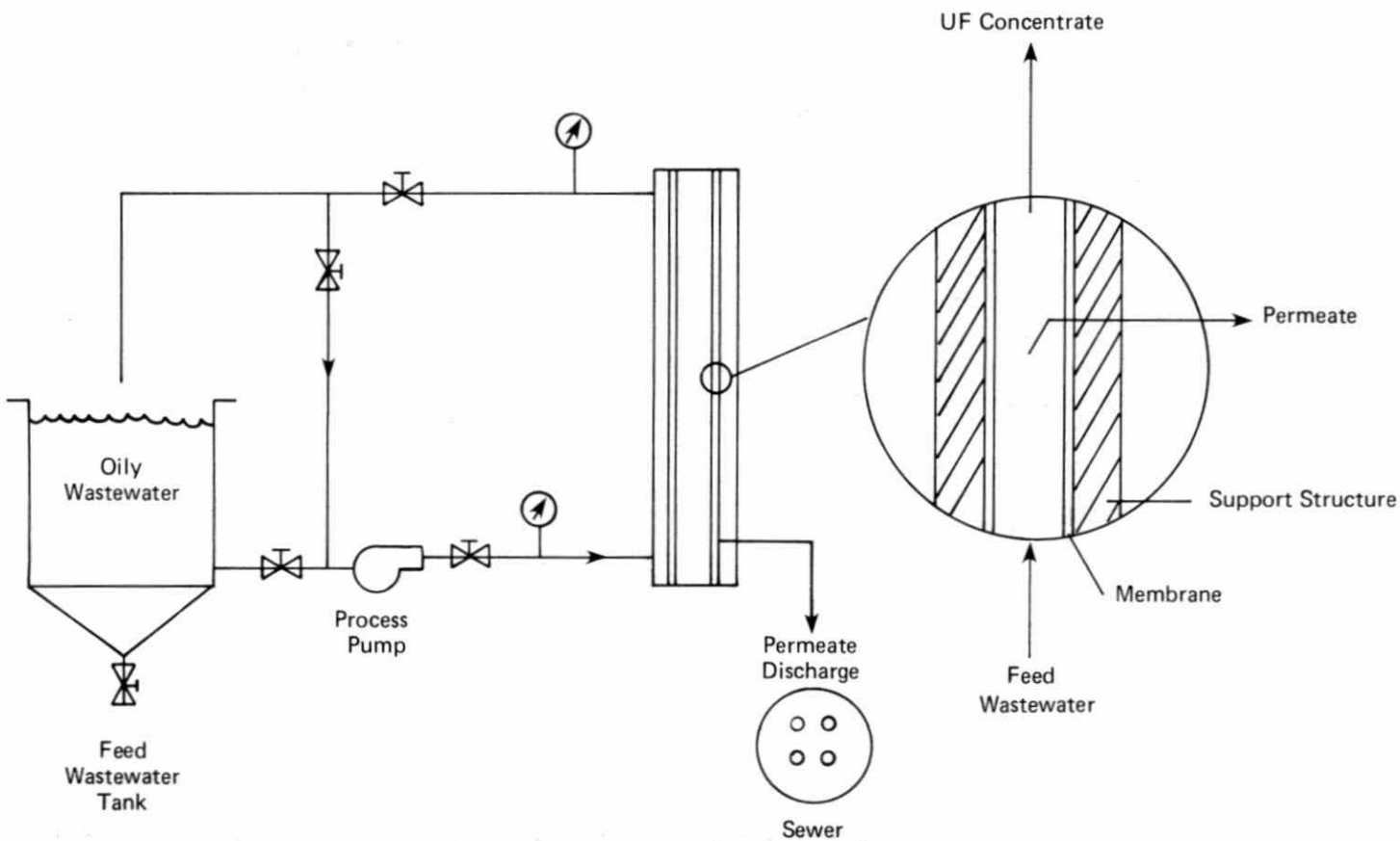


FIGURE IV

Increase in Total Dissolved Solids
With 10% Daily Make Up
TDS vs TIME

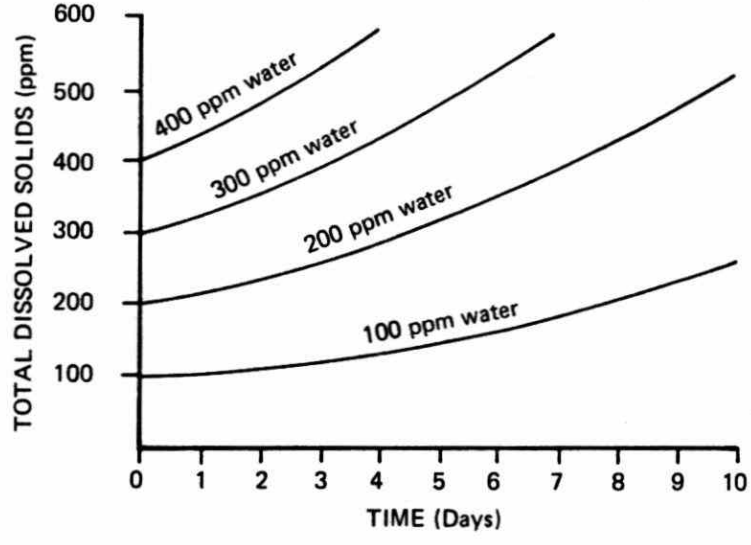
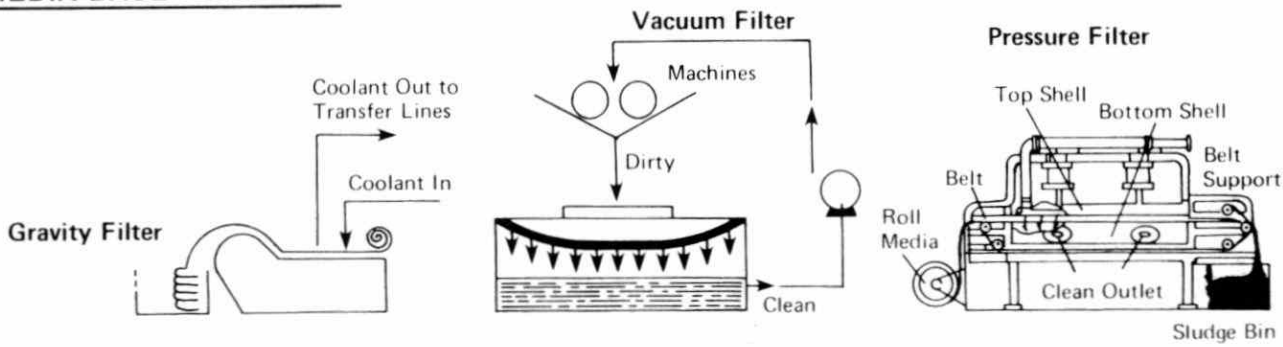


FIGURE V
CONTAMINANT REMOVAL SYSTEMS
FOR INDIVIDUAL MACHINE TOOL SUMPS

MEDIA BASED SYSTEMS



NATURAL FORCE SYSTEMS

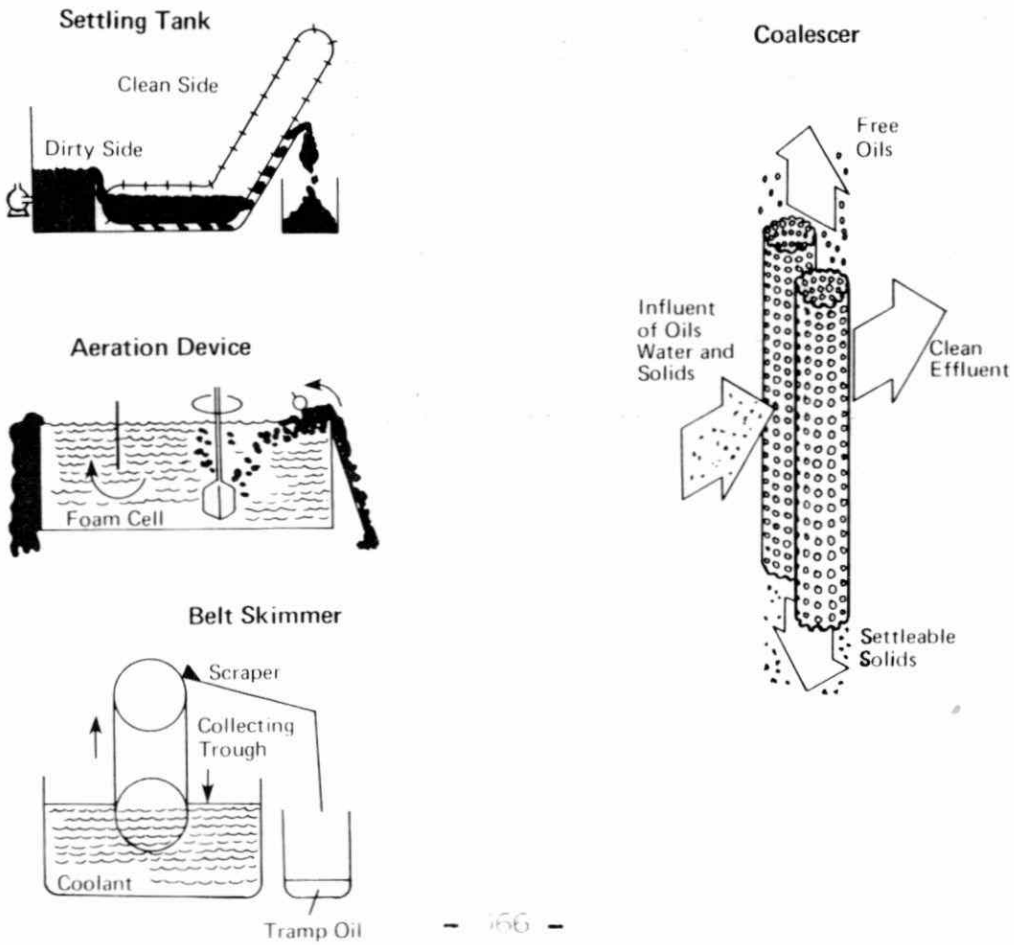
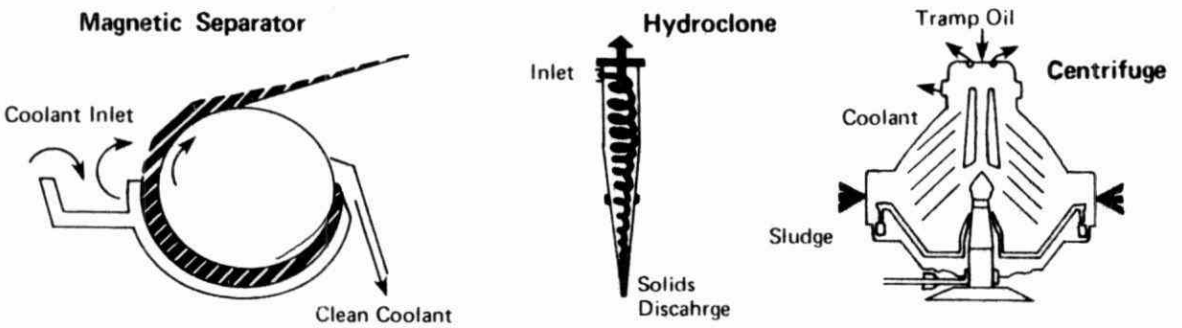
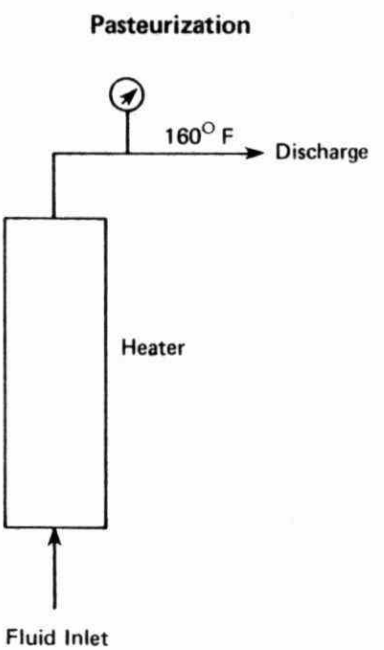


FIGURE V (Cont.)

MECHANICAL SEPARATION SYSTEMS



OTHER



Prince Hotel, Toronto, Ontario
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